TRANSACTIONS

—OF THE—

AMERICAN

FISH CULTURAL ASSOCIATION.

EIGHTH ANNUAL MEETING,

Held at the Directors' Rooms of the Fulton Market Fish Mongers' Association, in the City of New York.

February 25th and 26th, 1879.

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OFFICERS, 1879-80.

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New York City.

GEO. SHEPARD PAGE, - - - VICE-PRESIDENT.
New York City.

EUGENE G. BLACKFORD, - - - TREASURER.
New York City.

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Caledonia, N. Y.

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EIGHTH ANNUAL MEETING

—OF—

THE FISH CULTURAL ASSOCIATION.

TUESDAY, February 26th, 1879.

THE meeting was called to order in the Director's room of the Fulton Market Fish-Mongers' Association, in the City of New York, by the President, HON. ROBERT B. ROOSEVELT, at 11 A. M.

The President made some introductory remarks on the progress in fish culture during the past year, mentioned the hatching of cod-fish by the United States Fish Commission, calling attention to the objects of the Association, and the importance of carrying them out. So far the New York Commission had devoted their attention to two or three kinds of fish, but what scope there might be in the future no one could tell.

The President regretted that a confused nomenclature of our fishes in the matter of common or popular names still existed. He told of his own difficulties in making a man in one portion of the country understand what fish was meant when he called it by a name in use in some other part, an example of which was given in the *Stizostethium*, which is called a "pike" in some parts of the State of New York, a "pickerel" in Canada, and a "salmon" on the Ohio and Mississippi rivers; while the "great lake pike" (*Esox lucius*) is called a "pickerel" in some localities and a "pike" in others.

The Secretary, Mr. B. PHILLIPS, then read the minutes of the previous meeting, which were approved.

Numerous letters of regret from various fish commissioners were read, their absence at the meeting having been accounted for by their peculiar duties usually taking place at the close of February. It being evident then that the present date of holding the meeting was inconvenient for many of the members, it was resolved to hold the future meetings of the Association in March or April, the exact date to be decided by the Executive Committee, who were empowered to fix the time and make the call.

The reading of papers being now in order, the Secretary then read Mr. THOMAS CLAPHAM'S Paper on Food for Brook-Trout :

Two years ago when I commenced trout breeding and rearing, I knew nothing about the business except from such information as could be gleaned out of the directions given in various works on the subject. The rules laid down by these authorities, particularly as regards food for trout, both young and old, appeared so vague and contradictory, that I concluded to strike out for myself, take advantage of what nature offered, and thus, while suffering by experience, I might at the same time gain useful information from that harsh yet thorough teacher.

Believing there must be others who, desiring to rear trout, find themselves placed in the same position, I am glad to have the opportunity of giving them the benefit of what little I know.

In the first place I would say that the very best situation for rearing trout is on a never-failing spring-brook which discharges into the salt water, because in this combination we have all that is necessary, so far as nature is concerned, for success, with comparatively little trouble or expense.

Almost every living thing found in the sea is the very best of food, when properly prepared, for brook-trout.

For very young fry I have known nothing better than the belly of the common soft-clam. This may be fed in a raw

state, passed through a fine sieve, to the little fish, but it is not well to do so in this manner, for the reason that in this condition the food is in a glutinous state, partially dissolves in the water, and, adhering to everything it touches, quickly causes foulness, and consequently death, unless the greatest care be used.

I therefore boil or steam the clams until their shells open, separate the parts I wish from the rim or tough portion, and give it to the young fish through a fine brass seive.

The boiling or steaming appears to granulate the mass in such a manner that the resulting particles are of exactly the size and condition required, while being of a very light color, they are readily seen, and the fry will gather up every atom even from the bottom of the rearing-trough or pond.

Enough food for a million little trout can thus be prepared in fifteen minutes.

Such portions as are not given to the fry are fed to the large fish. My trout contend with each other to take these scraps from my fingers, and I do not know of any more fattening food.

As the troutlets grow I simply use a *coarser* meshed sieve, and by midsummer, when they can swallow larger particles, I run the clams, either raw or cooked, through a chopper.

The eggs of the horsefoot or king-crab are also excellent food for trout of three months old and upward. These horsefeet are found in great numbers on some shores. Their eggs and flesh are fine fish-food, and should be prepared by boiling, or roasting on an open fire.

Salt water minnows and shrimp are just the thing for large trout, and during several months I use them almost exclusively, as they can be taken at Roslyn, L. I., by the bushel.

Of course to those who establish themselves away from tide-water these hints will not apply, and to such I would say that calf or sheep liver, *boiled until it becomes brittle or granulated*, is an excellent food for the young fry. This, too, should be passed through a fine seive, and requires no other grating or chopping.

If one has for neighbor a large slaughtering-house, he need go no farther for *cheap* food, but in this case cheapness will be secured at the expense of delicate flavor in his trout.

I beg indulgence for consuming your time with matters which, to the old fish culturists, may appear self-evident trifles, but my own brief experience has taught me that these trifles are the stumbling-blocks over which we beginners have to trip, and I am satisfied that the difficulty of providing proper food at reasonable cost has been the one great cause of failure in rearing trout with profit for market.

The Secretary then read the following paper by MR. H. D. MCGOVERN of Brooklyn, on the New Enemies of Trout:

The question has been asked me more than once, "Why is it that our streams, which used to abound with fish, are so depleted, particularly of the young trout?" I at once commenced an investigation, and began to think why it was that the good old streams of Long Island, that used to furnish so much pleasure to the sportsman, were now almost untenanted by large trout. The question, I thought, could be easily answered, knowing that there were so many pot-hunting sportsmen around, in and out of season, who would not hesitate to kill a large trout even if they knew it was on the spawning-bed and in the very act of spawning. This, with the assistance of the mink and snake and other enemies, I thought would answer the question. But I was mistaken. I will pass the large trout for the present and give you the result of my investigation of the small fish. When I say small, I mean from one year to eighteen months trout. I was in the habit of placing some of the fish in a spring-well for general observation. As the water was clear, and the space narrow, it afforded me a good opportunity to watch the growth, habits, and movements of the speckled beauties. Several times I came to my spring and found some of the number missing. I examined the screens and found there was no chance of escape by that means. I then placed six eighteen-months-old fish in the spring. Next morning I found one missing. At 4 P. M. on the same day two were missing. On the following morning only two remained. Then I became alarmed and thought the fish were playing cannibal; so I determined to solve the mystery, if it took me the balance of the year. Knowing that one

of the fish was taken or disappeared between 10 A. M. and 4 P. M. the previous day, I began to watch, and was rewarded at 2 P. M. by noticing something crawl from under a bunch of water-cresses which grew on the edge of the spring. It first appeared like a mouse. When it reached the water it dove down, and like a flash it was up again, with something attached to it. I was not slow in capturing the intruder, and found to my surprise that it was a large bug, resembling a good-sized locust, having one of my small fish in his grasp.

Now, gentlemen, as I am no entomologist, I do not know the name of it, but from the manner in which it held the trout, I should call it a bear-bug, for indeed the poor fish was getting a bear's hug. Having placed it in a jar of water, it still held on to the fish, and seemed to enjoy its imprisonment. From observations with the naked eye, while the bug was in the glass jar, I could see that it tortured the fish from a tubular prong, which it cast from the tail and fastened on the fish. In a second the bug became inflated to double its size. Now, gentlemen, as our worthy Treasurer remarked, I think this is a "blood-sucking fisherman, and largely the cause of the depletion of our small fish." Being inquisitive to know if the thief would live out of water, I emptied the jar and placed some screen-work over the mouth for the purpose of procuring air. Next morning I found the bug, with his toes turned up, and his victim beside him; so I found, good fisherman as he was, he differed from the many anglers of the present day. Nothing but spring-water would suit his bugship, and enable him to feast on his dainty morsel.

Now, to return to the large fish. It is not very pleasant to find a large trout dead or dying without any seeming cause, as the fish would look healthy, and as proof of such, when captured and opened, you find that it had eaten a good feed a short time previous. One day last month I was feeding some large trout that had come down from the spawning-beds. Suddenly I noticed one of the number jump clear out of water, wriggle a moment, and then turn over. I took it on the bank and first examined to see if it had choked itself; but that was not the cause of death. I at once opened it and discovered a four-inch

red worm coiled up near the heart. I closed up the fish and folded it in paper, intending, as I did afterward, to take it to Mr. Blackford until we could hold an inquest. In the meantime some friends came to the pond. I went to show them the fish and worm, but, to my surprise, the worm was gone. I searched all the intestines, but without success, and was about giving up the search when, noticing a small swelling on the skin of the fish close to the ventral fin, about the size of a small pea, I cut the same, and found the worm coiled up under the skin as it was in the breast when I first discovered it. I have not yet received the name of the worm from persons versed in such matters, but I know, gentlemen, that it is able to enter a fish that it may attack and make its exit from it in less than a minute. From later observations, I have seen the worm crawl out and then disappear in the body of the fish in about half a minute. The spot attacked in this case was also near the ventral fin. Gentlemen, that this worm, in connection with the bug, accounts for the scarcity of fish in our streams, I have not the slightest doubt, and hope that all of you engaged in fish culture will look out for such things.

A discussion here followed as to the particular kind of "bug" mentioned by Mr. McGovern.

It was finally decided by Prof. A. S. Fuller to be the *Belostoma grandis*, and later in the day Prof. Fuller sent in a specimen which was recognized by Mr. McGovern as the one to which he referred.

Mr. McGovern here showed a trout which had been attacked by a parasitic worm which had eaten into its side. He stated that he had seen many such worms, and once found one which had bored its way through a trout from side to side.

MR. MATHER: The larvæ of the dragon-flies (*Libellulidæ*), are the most destructive to young fish in ponds of anything which I have met. I once placed five young gold-fish of half an inch in length in a bowl with a dragon-fly larva, and it devoured the five fish in about half an hour.

PROF. FULLER: The larva of all the dragon-flies are carnivorous, living upon the larvæ and purpæ of other insects, and no doubt will attack small fish. They are exceedingly strong and fierce.

MR. PHILLIPS read an article from a newspaper on the *Belostoma grandis*, showing that it had before this attracted attention, and had been well defined.*

The order of proceedings and papers to be read was then given by the Secretary, and the meeting adjourned until the afternoon.

AFTERNOON SESSION.

On assembling, at 2 P. M., MR. CHARLES HALLOCK read an article on co-operative game-laws, which referred mainly to deer, birds, and other game. It noted that the state laws for protecting black bass (*Micropterus*) were very different in adjoining states. MR. HALLOCK desired that a uniform law for the protection of fish be made, and the following resolution was passed:

Resolved, That this Association approves of any measure that will tend to simplify the protective laws for fish and game and make them as nearly uniform as possible in all the states; and that the plan offered by MR. HALLOCK goes far to secure the result.

MR. GREEN: The bass season in New York is from the 10th of June to the 10th of July.

MR. BLACKFORD: Black bass come into market in the month of October; the largest source of supply is from the South, in months of January and February, or during the close season in New York.

THE PRESIDENT: I will read from the amendment to the laws, as recommended by the Society for the protection of fish and game, those portions relating to trout, black bass, muscalonge, and wall-eyed pike.

*A full description, with an engraving of the Belostoma, may be found in the last Report of the New York State Fish Commission.

SEC. 21. No person shall kill, or expose for sale, or have in his or her possession after the same has been killed, any speckled trout, save only from the first day of April to the first day of September.

SEC. 22. No person shall kill, or expose for sale, or have in his or her possession after the same has been killed, any salmon trout, or lake trout, in the month of September, October, and November..

SEC. 23. No person shall kill, or expose for sale, or have in his or her possession after the same has been killed, any wall-eyed pike, black bass, Oswego bass, or muscalonge, during the months of March, April, May, and June.

MR. BLACKFORD: A stringent law is very desirable, but as the law now stands, a dealer may be punished by fine when perfectly innocent. On two occasions I have had trout shipped to me out of season, of which I had no knowledge until their arrival. A year ago five boxes were shipped to me from Canada without my knowledge. I supposed they were smelts. They had arrived before any word of advice. On opening the boxes, what did I find? I found they were Canadian trout. Quite innocently I might have been subjected to a fine of $30,000. The trout law varies in the different states, and in Canada they are allowed to be caught earlier than in New York, and persons ignorant of this often ship them. The law should be altered so as to protect innocent men. I should recommend that they be allowed to turn them over to the Society for the Preservation of Game.

MR. JOHNSON: Possession of them should be *prima facie* evidence of guilt.

MR. ROOSEVELT: This is a delicate matter; if fish are allowed to be sold out of season at all, it opens doors for an evasion of the law.

MR. BLACKFORD moved the appointment of a committee to frame recommendations on this subject, to be submitted to the Fish and Game Association for incorporation in the proposed amendments to laws.

THE PRESIDENT appointed Messrs. BLACKFORD, MATHER, and ROOSEVELT as such committee.

MR. E. G. BLACKFORD then read the following paper on Whitebait:

The object of bringing to the notice of this Association the following facts and opinions of this tiny fish, that has been the subject of so much discussion, is, if possible, to clear away the uncertainty that has surrounded the question since it has been added to the menu of the American icthyophagist. There have been, from time to time, as in the case of most other fish, some very learned disputes as to where it comes from, how it grows, and whether or not it be a distinct member of the herring family, or the young of some other fish. In order that we may fully understand and comprehend what Whitebait are, let us examine into its history in England, where the name first originated. Mr. J. H. Cannon, a gentleman who was examined before the English Fishery Commission, in June, 1878, states "That the toothsome little fish was not 'discovered' until about 1780, and that it was his grandfather who had the honor of introducing it to the British public. It would appear that its pre-eminent merits were not at first appreciated even by its 'discoverer.'" Old Mr. Cannon was a fisherman, and the first use to which he applied the tiny creature was the baiting of eel-pots. It was in this way that it came to receive its name, by which it has ever since been known. In the Natural History of British Fishes, by E. Donovan, published in 1809, is a plate, giving a beautiful picture of English Whitebait, and in the text Mr. Donovan expresses the opinion that they are the young of shad. In 1828, Dr. Yarrell, in a paper published in the "Zoological Journal," entitled "On the Supposed Identity of Whitebait and Shad," discusses the subject at great length, and gives it as his unqualified opinion that it is a distinct species of the herring family, names it *Clupea alba*, and claims to have examined specimens in which he found roe, and that he believed that they deposited their spawn during the winter. Yarrell states that the fishing commences at the end of March and continues until September, and that no other fry of any value swims with

the Whitebait. Richard Parnell, in his "Fishes of the Firth of Forth," thus describes the appearance of Whitebait: "Color of the upper part of back, from the nape to the tail, of a pale greenish ash; sides, gill covers, pectoral, ventral, and annul fins, of a beautiful pure white; dorsal and caudal fins, straw color; scales thin, very deciduous; under jaw longest. In their habits they appear to be similar to the young of the herring, always keeping in shoals and swimming occasionally near the surface." Gunther, in his "Catalogue of *Fishes* in the British Museum," states: "As regards the Whitebait, this is a purely nominal species, introduced into science by Yarrell and Valenciennes in deference to the opinion of fisherman and gourmands." All the examples of Whitebait he examined were young herrings, from one and a half to three inches in length. At the present time it is accepted as a well settled fact by all English ichthyologists and naturalists that the Whitebait is neither more or less than the young fry of the herring family, which is fully assured from recent experiments at the aquarium in Brighton, England, where some live Whitebait, about one and a half inches long, were placed in one of the tanks, and in a few months developed into herring of about nine inches in length. Much of the discussion in England over this fish arose from investigators having confounded different species of the genus *Clupea*. Keeping the results of the investigations of our English cousins in mind, let us now take up the history of Whitebait in American waters. In the early part of the year 1876, Mr. Charles Waite, one of the proprietors of the Windsor Hotel, in this city, suggested to me that I get some of our fishermen to bring in some very small fish, about one inch long, as they would be a great delicacy for the table, and, in his opinion, would equal the famed Whitebait of England. This led me to make inquiry in various quarters as to the character, appearance, and habits of this fish, and in April, 1876, I received from Liverpool, through the kindness and courtesy of Professor T. J. Moore, of the Derby Museum, some specimens of English Whitebait. After examining these, I was convinced that the same fish could be found in our waters. Shortly after, I met Mr. J. Carson Brevoort, and knowing that he had fished the waters of New York

Bay very extensively, while engaged in his researches into the habits of fish found on our coast, I asked him if he ever found any fish in his nets resembling Whitebait. He assured me that he had, and that they would be found in the vicinity of Bay Ridge. In the spring of 1878, I requested a shrimp fisherman to bring me all the small fish he might find in his net when fishing for shrimp, and on April 16th he brought me three small fish that were identical in appearance with the English Whitebait. The next day he brought about fifty specimens; some of these I sent to Professor Spencer F. Baird, who, after examination, wrote me that they were "the young of two distinct species—one the *Pomolobus pseudoharengus*, the common Alewife, or *Gaspereau;* the other the *Pomolobus mediocris*, or Sea or Taylor Shad." Having determined that they were not the fry of any of our valuable food fish, I took measure to procure a supply for table use; obtaining which, I sent them to the Union Club, where they were served, and the superintendent, Mr. Chisholm, informed me they tasted so much like the English Whitebait that some of the members supposed that they had been imported from the other side. After receiving this verdict on their superiority as a table fish, it only remained to introduce them to the public, which was done at a dinner given upon the opening of the Manhattan Beach Hotel, Coney Island, on May 15th, 1878. This was the first Whitebait dinner ever served in this country. The demand at once exceeded the supply, as at no time during the season was over sixty pounds taken in one day. They were sold at fifty to seventy-five cents per pound. The great call for these dainty little fish led the fishermen and some of the dealers to supply the demand with a small fish that is found in our harbor in large numbers, and called by the fishermen "spearing," a very inferior fish for table use, which fact epicures soon discovered, and the price soon declined so low as to make the catching of them unprofitable. These spearing are a species of anchovy, *Engraulis vittatus*, and differ but slightly from the famous anchovy of the Mediterreanean, *Engraulis encrasicholus*, which is so prized by good livers in the form of anchovy sauce and anchovy paste. They may be easily distinguished from the Whitebait, as they are totally unlike

in appearance, the anchovy being marked by a bright silver band running from the opercle to the caudal fin, the entire body of the fish. with the exception of this band, being semi-transparent, of a milky color, which turns to a red soon after they are taken from the water. Still another species, the "Silversides," or "Friar" (*Chirostoma notatam*), is often sold as spearing. The true Whitebait, the young of the *Pomolobus* family, present a uniformly silver appearance over the entire body, and are covered with minute deciduous scales; the color on the back is greenish ash, the abdominal line serrated from the pectorals to the caudal fin. They are caught in our harbor at Bay Ridge and along the shore of Coney Island, but the most plentiful supply is found in Gravesend Bay. They are usually seen swimming about a foot below the surface, are most numerous about the first of June, and disappeared entirely last year about the first of July. Mr. Albert Voorhees, fisherman at Gravesend, informs me that when he lifts his pound-nets in which he takes weakfish, he could see thousands of the Whitebait going out through the meshes of the net, and that the stomachs of the weakfish are often full of them. In his opinion they are the principal food of the weakfish during May and June. If he lifts his nets at another time than in slack water, no Whitebait are to be seen. Some apprehension has been felt by fish culturists, that in taking the Whitebait, the young fry of the shad might be destroyed, thus neutralizing the efforts of our New York State Fish Commission in stocking the Hudson; but when Whitebait are most abundant, the shad has only just commenced to spawn, so I think we may sit down to a Whitebait dinner without any feeling that we are inconsistent with our professions as fish culturists.

MR. BLACKFORD here exhibited a jar of Whitebait in alcohol, to show that it contained no young shad.

MR. ROOSEVELT: Have you ever found young shad among them?

MR. BLACKFORD: No. The only other fishes which I have found have been one mackerel and two young bluefish (*Pomatomus*). After the month of July the only fish mixed with Whitebait is

the "spearing," or anchovy. Professor BAIRD informs me that on the coast of Maine the young of the alewife (*Pomolobus pseudoharengus*) can be caught by the ton, but if Whitebait are not cooked on the same day on which they are caught they are valueless.

MR. HALLOCK: I think that Whitebait are two-year-old herring. The herring spawns near shore in the seaweed.

MR. BLACKFORD: Too many young fish are destroyed when they should be protected. I would advocate prohibiting the catching of all fish under a certain size, as small bass, etc., and even, it were thought necessary, I would include Whitebait.

A question was put here by a member as to the method of capturing striped bass (*Roccus lineatus*) on the Hudson, in winter, and whether it was not hurtful to the fishing interests of the state.

MR. BLACKFORD: A net, the twine of which is as fine as sewing-thread, is set in a canal, or trench, cut in the ice. The large fish seem dormant. Though many fish are caught, their number does not diminish. What we all are opposed to, is the catching of striped bass two and three inches long. The Fish Mongers' Association is in favor of such a prohibition, and a penalty for catching such fish.

MR. JAMES ANNIN, JR., then read a paper on Trout in Hard Water:

I have no doubt that this subject has been well understood by many of you for some time, but I trust you will have patience with me while detailing some of my own personal experiences in the matter.

At the last annual meeting of this Association I asked for information as to eggs of brook-trout, taken from hard and soft water: "If those taken from the fish inhabiting soft waters would bear transportation as well as those taken from the fish of hard waters?"

By the Report, it would appear I was not properly understood.

Mr. Seth Green gave his opinion, based on information received from one of his men engaged by Green & Co., in this state, that eggs taken from soft-water fish did not appear to stand handling as well as the others.

For the past three years I have had my attention called to this subject several times, and will, in a few words, present some of the conclusions I have come to as to the advantages and disadvantages of soft and hard water for trout breeding and raising.

The eggs taken in soft water (as I have found them) have a much thinner shell.

After they have made a journey and are unpacked and put in hatching-troughs, for the first day or two some dead eggs may be picked out ; but in about a week, the time depending on the age of the eggs, many begin to hatch prematurely, head first, and die before getting entirely out of the shell ; and many others, after hatching, have what is termed the " blue-swelling." I have seen some lots of eggs of which 50 per cent. have been picked out dead from the time of unpacking to a period of 30 days after hatching, owing to their shells and "blue-swelling ;" but on the other hand, I have often seen a much better showing. But soft water has its advantages. When the eggs are undisturbed, they turn out well, the fry flourish and grow faster and with less mortality than in hard water. At one year old they are in many cases as large as two-year-olds of hard water.

As a general thing, I do not think, from what I have seen, that food alone, or a variety in food, makes the difference in the growth ; for in our stream at Caledonia, the water of which is hard, I never saw as much and as many different varieties of food, but for all that our fish grow slowly.

Eggs taken from hard-water fish seem to have a very strong shell. Mr. A. S. Collins once said to me, "It was about the same with them as in the case of hens that had plenty of lime —that their eggshells would be very hard and strong.

I do not wish to be understood by this that I consider one kind of eggs any better than the other, only as far as transportation goes.

I have planted eggs from Caledonia in soft-water streams

and ponds, and know that they have done better than they would in our own hard water; and, on the other hand, have received eggs from soft-water establishments, and after the first month found that they do no better than the natives of our water.

But I do consider our trout as good as the best in the country for the table. In New York many consider the Long Island fish best, but let the streams of Long Island be four or five hundred miles from the New York market, and I doubt if such would be the case.

MR. WEEKS: I would ask if Mr. Annin includes all soft waters?

MR. ANNIN: I could not well do that, as I have not handled eggs from all the soft waters in the country. I only include those with which I have had experience.

MR. WEEKS: Our water in western Pennsylvania is soft. I obtained my first stock of trout-eggs from Mr. Annin, and they were good. I have bought many eggs, some from Cattaraugus County, N. Y., from soft water, had a very thin shell, and were nearly all lost in transportation.

Mr. S. M. JOHNSON, of Warren Bridge, Boston, then read the following paper on Lobster Fishery and how to protect it.

This, like all questions having for their object the best method of economizing and preserving our supply of sea food, has become not only of great interest, but of great importance. and the discussion of such topics are looked upon with increasing interest from year to year, as the necessity for a law in relation to them becomes more apparent.

With these facts in view, I esteem it a privilege to accept the invitation of the Secretary of this Association to consider briefly the causes of a very apparent decrease in the size of lobsters offered for sale in our markets.

The first question seems to be what relation the supply bears to the demand, and the ability of the former to meet the later in the future as well as the present.

In looking for a reasonable solution of this problem, an inquiry concerning the means taken to provide the supply now as

compared with those taken in former years, might properly be prefaced by a statement of the fact that not as many lobsters are consumed now as formerly. A few years ago fifty or sixty traps per man was considered a good number, while at the present time from seventy-five to ninety are used, and even with this addition it requires twice the number of men to catch the same amount of lobsters.

These facts seem to show the danger of depletion in our efforts to keep up the supply, even if size and quality are disregarded.

It may be fairly estimated that from twenty-eight to thirty millions of lobsters are taken annually off the coast of New England, aggregating in weight not far from 15,000 tons.

These figures may be considered only important here when taken in connection with the ability of the source of supply to furnish this amount without endangering its perpetuity.

This calamity, however, I think most likely to ensue unless some proper restrictions are enforced limiting this continual drain. When we compare the lobsters seen in the market to-day with those of former years, this danger becomes still more evident, and if this decrease in size goes on, the industry will in a short time become of little or no importance.

The reply to the oft-repeated question, "Why do we not get larger lobsters?" must be, "We catch them faster than they can grow." The smaller the lobsters we retain, the smaller they will become in the future, and as a natural consequence, if we continue indiscriminate fishing, practical extermination must follow. This ground I am anxious to maintain, and wish to have some remedy applied to obviate the evil; still, however, permitting a partial supply.

Before going further, I would here give you a brief description of the process by which a lobster discards its old shell and assumes a new one.

Having grown to fill the old shell, a new one begins to form under it, at first no more than a film, which, gradually thickening, becomes in appearance not unlike India rubber.

The line seen running lengthwise of a lobster's back indicates the opening point which, when opened, room is provided

for the extraction of the tail, together with the legs and bony structure of the body.

Next comes the interesting, but apparently difficult operation of drawing the large claws through the small joints, by which they are connected to the body or trunk, but this is easily accomplished by a beautiful yet simple provision of nature, viz.: the decay of a portion of the shell, thereby forming a larger aperture. The place is indicated by an oval spot, seen on the inside of the first joint of the arm.

This done, the animal is free from its shell and bony structure; for let me state, the bones assisting in the working of joints are also withdrawn from the flesh, leaving him helpless, and as if dead, the beating of the heart being the only visible sign of life. In a few days, however, the new shell is hard enough to permit the seeking of food, which is done with great eagerness.

But more especially to the result of this process would I call your attention.

From actual observation, I have found that a lobster measuring ten and one-half inches in length will, after shedding, have increased to twelve inches; but if we make the comparison in weight, it may be better understood; for instance, a lobster of ten and one-half inches will weigh one and a quarter pounds, while one of twelve inches, on an average of two and one-half pounds, or double its former weight, which will add to its market value in the same proportien, or 100 per cent. Now if a lobster sheds his shell once a year, which is approximately true, I think that it shows that by establishing a reasonable standard of length (which must not be so high that it would prohibit fishing, neither so low that a sufficient age for reproduction may not have been attained), we may, in time, get back that which we have so foolishly sacrificed.

Lobsters of a less length than ten and one-half inches have been found, bearing eggs, but by careful observation and inquiry I have found the exceptions to be very rare; therefore this standard could not be safely fixed under that length, but should, on the contrary, be as much above it as possible, still not so high at first as to cause hardship to the fishermen, while from time to

time an advancement might be made as the supply of the required length increased and more nearly met the demand.

Having pointed out the necessity of such a law, and indicated the best mode of its application, it only remains to be shown how it may be made effective.

I think it is an established fact that protective measures can only be carried out in the open market, where the possession of unlawful fish or game is "prima facie" evidence of guilt.

Such a law has been in full force in Massachusetts since 1874, but the possibility of finding a market outside the state has been a barrier to the best results, and just so long as there is any place where lobsters may be indiscriminately sold, we cannot justly judge of its efficiency.

I am fully aware that in advocating a measure of this kind opposition will arise which must be met and answered in the most tolerant spirit, for fancied rights of individuals are not always in accordance with the reasonable demands of the public good.

The first opponents of the law for the protection of lobsters in Massachusetts were the fishermen, whose testimony at the same time was the best evidence given of the necessity for such a law. These, however, after a trial of one year, not only became reconciled to it, but even its strongest advocates, and realized year by year more fully the wisdom of the measure they so bitterly opposed.

There has been one circumstance noticed which I think quite significant, viz.: that the first year the law went into effect one-fourth of the whole number caught were obliged to be thrown back on account of their insufficient size, which proportion has gradually diminished, until at present scarcely more than one in ten is discarded.

The state of Maine, which possesses the largest lobster-producing grounds on the coast, has, from time to time, passed laws for the protection of the lobster fishery, but has had a powerful and important interest in opposition to a limit which no other state has, the size being of less importance for canning purposes than for other consumption.

This year, however, a law has been enacted by which the

canners are obliged to confine their operations to four months of the year, while for the remaining eight months a limit of ten and one-half inches is required, and I think may be looked upon as a great step in advance of any law previously passed.

This movement was made by the fishermen in the form of petitions to the legislature, numerously signed, and from one end of the state to the other.

Maine, New Hampshire, Massachusetts and Connecticut, each have laws practically corresponding to each other, while New York, without a law, which might so much assist in protecting the other States, only helps on illegal and wasteful practice.

MR. BLACKFORD: I would like to hear the fish dealers' opinion on protecting lobsters; they often buy small, cheap, and worthless lobsters because there are no others offered, and competition is so strong that they must supply their customers with something in shape of a lobster when they demand it.

MR. JOHNSON: A lobster, immediately after shedding its coat, increases in size fully 100 per cent., and if thrown back into the water for another season would double its size.

MR. S. B. MILLER: We would only ask Massachusetts not to send us small lobsters.

MR. OSCAR COMSTOCK: As a dealer, I would approve of protective laws for lobsters; that is, to forbid their being sold under a certain size.

MR. ROOSEVELT: As a consumer I find that nine out of ten are worthless and light; it is difficult to get lobsters of a decent size; the large ones have become very scarce.

MR. BLACKFORD moved that the lobster question be referred to the committee before appointed to suggest additions to the fish and game laws, which was carried.

The following gentlemen were proposed for membership and elected:

C. F. Fearing,
R. L. Stuart,
G. W. Van Siclen,
John E. Devlin,
S. M. Johnson,
H. H. Thompson,
Townsend Cox,
H. T. Carey,
W. M. Fliers,
J. H. Thompson,
W. A. Conklin,
C. G. Whitehead,
W. Holberton,
H. C. Hilmers,
C. A. Lewis,
J. A. Lowery,
E. M. Stillwell,
E. J. Anderson,
Owen M. Chase,
J. C. Roach,
G. H. Brush,
C. H. Andarlese,
J. Reynal,
E. R. Wilbur,
S. Weeks,
J. B. Morgan,
P. Kelly,
J. H. Layard,
G. N. Lawrence,
E. Gilbert,
T. Reinecke,
J. S. W. Thompson,
Theo. Morford,
A. Conselyea,
J. P. Trimble,
Henry Steers,
J. L. Janney,
J. Mullaly.

SETH GREEN then read the following paper on Stocking Waters with various kinds of Fish:

The key to the successful stocking of our waters with fish, is in putting the right kind in their respective waters—those that are suitable for them. There would be quite as much sense in sowing wheat on the bare shingles on the top of your house as to put fish in waters that are not suitable for them. You would be astonished to read some of my correspondence, and to see how little many men know about the waters that are suitable for the different kinds of fish. That is the reason that all parties writing me are requested to give a full description of the waters they wish to stock, and if they give me a correct description, we hardly ever make a mistake. I frequently have men who insist on trying certain kinds of fish in their waters that I know would not live, and I have made some enemies by not giving them the fish. But I would rather have their displeasure than to put them to an expense and be no benefit to them, besides killing just so many fish.

I am like most of men that have been successful in raising anything. We look on it with a good deal of pride, and love the little fish that we have watched from the time the egg was impregnated to the time they are to be put in the water to take care of themselves. It would be a very wrong thing to put them in waters where they were sure to die. Brook-trout are only suitable for clear, cold waters of which the temperature never goes above 70 deg. They will die before the temperature reaches 74 deg. Salmon-trout will live only in clear, cold, deep lakes. They need the purest water of any fish in this country. I have put brook-trout, salmon-trout, greyling, California and Kennebec salmon and California brook-trout in a large aquarium, and as the water became warm the salmon-trout began to suffer first.

There were two each of the above kinds of fish in the aquarium. They all died before the mercury went up to 74 deg. The salmon-trout died first, brook-trout next, greyling next, California brook-trout next, Kennebec salmon next, and California salmon last. The salmon-trout died twelve hours before any of the rest, and all of the others died within four hours of each other. The above fish were all three years old, and I have tried all of the above kinds of fish by roiling the water with the following result: The salmon-trout dying first and the brook-trout next, and the others soon after.

All of the fall spawning-fish want clear, cold water. The whitefish will not live in water above 72 deg. I have seen a haul of whitefish come in in a seine, and when they got in shallow water where the temperature was 74 deg., ten rods from shore, the fish began to turn up, and all were dead by the time they were hauled up on the shore. When water gets to a suffocating state the fish will not live as long in such water as they would live out of water. The spring and summer spawning-fish, such as the bass, will live in water as high as 86 deg., or even warmer. Black, or lake bass, need purer water than many other kinds; they will not do well in small waters. They want large, rocky rivers, or lakes with rocky bottom, where there are craw-fish and dobson. It is useless putting them in waters that have no rock bottom. They will not do well in any waters that have all

mud bottom. Lake, George is a beautiful lake for black bass, and they have been in the lake for a number of years, but they do not seem to do well. Last summer I went down there and made a thorough examination, and I found there were no craw-fish in the lake. So I had 18,000 put in, which will soon stock the lake, and I have no doubt will make Lake George one of the best bass lakes in the state. Craw-fish are great breeders. They carry their spawn under their tail until hatched, and after these are hatched they carry their young until they can take care of themselves. I think it is safe to say every mature female craw-fish raises 500 young every year.

The black bass is an excellent fish to stock waters that are suitable for them, for the reason that they make a nest and lay their eggs and watch over them until they are hatched; then they take care of their young until they have learned to feed and provide for themselves. The young are hatched without any, or scarcely any sack, and need a mother to teach them to feed. Black bass can be hatched artificially as surely as any other fish, but the mother hatches as large a percentage as could be hatched artificially, and it would be difficult to feed the young after they were hatched. The black bass is a hardy fish. They stand transportation well. I sent last spring 113 to California by my son and Mr. Mason. They arrived there with ninety-nine in good order. They were mature bass, and I have no doubt they will be heard from. Waters suitable for Oswego bass should have a mud bottom, with weeds and flags and pond lilies. They do well in millponds or in any still water. They eat any living thing that is of the right size for them to swallow. They breed the same as the black bass. They are a very difficult fish to transport in cans. It needs the best of care to get a shipment through without losing a good many.

Striped bass (*Roccus lineatus*) are easy fish to transport in cans. Last summer I transported 140 from the Hudson to the Genesee river. They were six inches long. I do not know what the result will be. I have not heard from them since they were put in. It is too early yet. White, or silver bass, are a good fish, but do not do well except in a particular water. They would live in any waters that black bass would. It is the next thing

to an impossibility to transport white or silver bass in cans. We have lost a larger percentage in transportation than any other kinds of fish. Rock bass and yellow perch and bull-heads are good fish to put in some waters. All large waters with soft bottoms are suitable for bull-head. They are great breeders. They make a hole in the muck or bank large enough to admit themselves, and then dig out a room two feet in diameter and lay their eggs and watch over them until they are hatched, and take care of their young for three weeks. Six years ago I put 600 bull-heads in Chautauqua Lake, and for the last two years any parties wishing a quantity of these fish can go and take a pailful in a short time. This is but one of many successful attempts with these fish.

Four years ago, Mr. Newell, a gentleman living in California, sent me 500 California brook-trout spawn. I hatched and raised them, and have now 264; some of them weigh two and one-half pounds. Last March we took 60,000 spawn from them. We distributed all but 20,000, which we are raising. They are a great deal easier raised than our brook-trout, and I would like to see large shipments of the spawn made to the Atlantic states. I think they will do well in many of our waters. I am quite certain that we have many waters that the Meland river-trout would do well in, and would like to see larger shipments of the spawn made here.

Grayling seem to lose their breeding faculties as soon as they are removed from their native streams in Michigan. Seven years ago I went to the Ausable river and took some grown fish. I brought eighty-four to the New York State Fish Breeding-house. I arranged good places for them to spawn, but they never have shown any signs of going on the beds, and never have spawned since we have had them. I do not think that grayling would be a profitable fish to put in our waters. I hatched the spawn that I took at the river and raised the young, and they never have shown any signs of breeding.

Salmon are a good fish to stock any waters that are suitable for them. They want rivers with no obstructions from the sea to the head, and that head must be clear, cold water. We have not salmon streams enough in this state to pay the expenses.

We have distributed a good many salmon, and never have heard of any of them after they were one year old, except one that floated ashore in Cayuga Lake, weighing three pounds. We have some California salmon at our state works that are four years old; the females weigh one and one-half pounds, and the males three-quarters of a pound. They stopped growing when they were three years old. Of the Kennebec salmon, the females of the same age weigh two and one-half pounds, and the males one and one-half pounds.

There are various opinions as to the time spawn can be taken and left in a pan before the milt is put on them. I think I have heard parties say that they had put the milt on the eggs an hour or more after the spawn was taken, and impregnated a fair percentage. I have experimented, but it was so long ago that I had forgotten, and I could not find any minutes. This winter I had my brother make the experiment. He took fifty brook-trout spawn in a pan, and in five minutes, exact time, he put the milt on them. Then he tried fifty more, and left them ten minutes; fifty more, and left them fifteen minutes; fifty more, and left twenty minutes; fifty more, and left twenty-five minutes, and so on up to forty-five minutes. After thirty days we could tell what portion of the spawn was impregnated. We found of the first fifty only two impregnated, and not one impregnated after five minutes.

My opinion is that when the spawn is taken from the fish, the sooner the milt is put on the better is the impregnation, and the more carefully they are handled the better. I have seen parties handle fish-spawn as though they were peas, and claim that they hatched a fair percentage. My experience has been such that I cannot believe it, and I think it wrong to have such publications go before the community as facts.

The meeting then adjourned until 11 A. M. the next day.

SECOND DAY'S PROCEEDINGS.

WEDNESDAY, February 26th, 1879.

THE PRESIDENT, ROBERT B. ROOSEVELT, called the meeting to order. Further discussion was held on other insects attacking fish, and Dr. A. S. Heath, chairman of the Farmers' Club, read the following:

Dytiseus Marginolis—Water Butts. An oval body, legs curved and widened into oars, provided with hairs. They imbibe air at the surface of the water like the porpoise. They are amphibious, and fly from pond to pond to satisfy their voracious appetites. They are of a dark greenish brown color, yellowish on the sides. The front legs of the male are provided with suckers. It pierces the fish between the head and thorax. The Dytisci and Cybisters are both insect sharks, and attack everything which lives in still water.—*Insect World*, by Louis Fignier, 1869.

Dr. Heath illustrated his communication with sketches on the blackboard, and the form of a French insect was shown which resembled a water-beetle.

DR. HEATH: I was not aware that water-beetles lived upon fish, although they are generally carnivorous. Some insects have a long ovipositor, which is often mistaken for a sting, but is only used to deposit their eggs in such favorable places as the nature of the larva may require.

MR. GEORGE S. PAGE presented the following paper on the Teredo:

The name of our Association indicates that its transactions refer solely to the increase of food fishes, and heretofore the papers and discussions have been confined almost exclusively to that department of science; but I have assumed that information concerning the most destructive of marine animals, and practical

appliances for preventing its ravages, would certainly be within our province. As the boundaries of our field of observation and inquiry must rapidly enlarge, permit me to suggest that a change be made in the designation of the Association. Would not "The American Fishery Society" be far more expressive and inclusive? This would correspond to the title of the greatest of the European associations, "The Deutscher Fisherei Verein" of Germany.

I deem it of equal importance to instruct our fellow-citizens concerning the vast losses incurred by the unceasing ravages of the destructive denizens of fresh and salt water, as to enlighten them upon the subject of the best modes of propagating trout, bass, shad, and salmon, or restoring depleted public and private waters. We have all been deeply interested in the graphic remarks of our friend, MR. MCGOVERN, concerning that terrible freebooter of the trout ponds, who lies in wait for the unsuspecting salmon, pounces upon him with the speed of an arrow and with the cruelty of a shark, soon returning for other victims.

It is true the teredo does not attack our food fishes. It confines its assaults to the boats, vessels, and docks of the fishermen, to the bridges, wharves, and piers of our harbors, and to the shipping that is engaged in domestic or foreign trade. Its habitat is from Newfoundland to the River Plata on the Atlantic, and from the Straits of Magellan to Alaska on the Pacific. It is also found in the salt waters of nearly every quarter of the globe. It is most destructive in warm climates. A low temperature of the water destroys them. In view of the five thousand miles of our eastern and western ocean front, our numerous harbors, the millions of dollars invested annually in the construction of docks and bridges, this question is one of vast importance to our country.

The teredo is developed very rapidly from an egg. In four days the hard, shelly head is in condition to begin its action upon wood. Aided by the current it comes in contact either with the planking of a ship, the piling of a bridge or pier, and attaching itself by the use of its sucker-like tongue, it speedily makes a minute opening by the aid of its hard, shelly, combined

auger, file, and gouge. The best invention of the kind was patented a short time since—a Massachusetts mechanic copying exactly the tool of the teredo.

They enter the wood perpendicular to the surface, and they usually turn and follow the fibre upward. They grow rapidly, and their galleries increase in diameter. As they progress they deposit a white, calcareous coating on the interior. The sawdust enters the abdominal cavity, and is ejected by one of the two siphons that remain extended from the opening in the wood. Some naturalists have stated that the teredo feeds upon the wood. The best authorities claim, and undoubtedly with truth, that they enter the wood simply to create a home, but procure their food from the water, using the second of the two siphons.

In the Gulf of Mexico they grow to the length of a foot in one year. Their galleries are then about one-fifth of an inch in diameter. They rigidly respect each other's rights of occupancy. They never cut into each other's openings. They have the power of retraction to the extent of an inch. When they approach within the thickness of a sheet of paper to a fellow-traveller's path, they withdraw, and go around him or start in another direction. So thoroughly do they excavate the interior of massive timber, that the piles break off by their own weight. During the year 1875, twenty-one heavy oaken piles, driven on the outer end of one of the new coal docks of the Delaware, Lackawanna and Western Railroad Co., Hoboken, N. J., were attacked by the teredo. In six months they were actually eaten completely off at a point about ten feet below mean low water I have a section of one of these piles given me by the foreman of the dock-builders who constructed it.

The teredo requires clear, pure salt water. They are never found in timber situated near the outlets of sewers or gas-works. Fresh, or even brackish water kills them. Hence the number of uncoppered steamers, sailing vessels, and barges that are seen in the summer-time moored at Rondout and other points on the Hudson River, sent there to insure the destruction of the marine worms that have lodged in their planking.

The teredo cannot exist except in his woody chamber. Withdrawn from it he dies in twenty-four hours. It will live for

several days in wood well moistened with salt water. An interesting experiment is to obtain a section of wood containing the teredos; separate it so that the gallery of one or more is exposed, place it in an aquarium, and its remarkable action can be plainly observed.

In addition to the shelly head, the teredo is provided with an ingenious appendage at the other end. Should sediment, a barnacle, an oyster, or other disagreeable neighbor, attempt to close up its minute orifice, two small, shelly attachments, resembling a half-round wood-file, are protruded from the opening, and the intruder kept away, while the entrance is slightly cut and cleansed by these files.

In Aspinwall harbor, the East Indies, and a few other places, the teredo grows to the length of four feet, and over an inch in diameter. I have in my possession a section of a mahogany log from the former port, filled with perforations seven-eighths of an inch in diameter. In the Museum of Natural History, Boston, I have seen the hard, calcareous case-lining of the teredo, from the East Indies, over one and one-eighth inches in diameter. Its occupant must have been four feet in length.

The wonderful boring apparatus of a mature teredo contains 20,500 cutting surfaces, forming its ingenious file. Its sound is frequently detected by seamen while lying in their bunks. A sea-captain informed me that during a recent voyage he was caused much anxiety by the presence of the teredo in his ship's timbers. He could plainly hear them boring through the wood as he lay in his berth at night. Undoubtedly many a fine vessel, never heard from, met her fate through the persistency of these "wreckers."

I have brought here many interesting specimens illustrating the ravages of this animal. In these glass tubes are several teredos from 12 to 22 inches in length, and from one to two years of age. They were obtained by my friend, J. W. Putnam, Esq., Superintendent of the Wood Creosoting Works of the New Orleans and Mobile Railroad Company, at Pascagoula, Miss. Here are specimens of yellow pine, spruce, white pine, and mahogany, obtained respectively from the Gulf of Mexico, San Francisco, Wilmington, N. C.; Norfork, Va.; New York, at the

Battery ; Delaware, Lackawanna and Western Railroad Co.'s docks, Hoboken; New Haven, Provincetown, Massachusetts, and Aspinwall.

You will notice several sections that are only partially eaten. The teredo plainly avoided the dark, stained portion. This latter part was saturated with the creosote oil of coal-tar. This substance has been found to be an entire protection against the ravages of the teredo. Please notice that the two specimens of yellow pine are creosoted, the other not. They were sent by my friend E. R. Andrews, Esq., of Boston, to Capt. Truxton, Commandant of the Norfolk Navy Yard, June 1st, 1878, and exposed five months in the harbor. The uncreosoted specimens are extensively perforated ; the creosoted section are untouched. Piling and timber are placed in a large iron cylinder, one hundred feet long and six feet in diameter. Steam heat at two hundred and forty degrees vaporizes all the sap, which passes off through pipes. The oil is passed in, and powerful force-pumps press the oil to the centre of the heaviest timber. Ten pounds of oil to the cubic foot is sufficient to protect it for many years from not only the teredo under water, but also decay above water. Extensive docks and piers in Great Britain, France, Belgium, and Holland have been thus preserved for over thirty years in waters where the teredo would otherwise have destroyed them in from two to four years. It is only seven years since creosoted timber was first used in the sea in this country. All that has been done here is still perfectly sound, and will undoubtedly equal the life of creosoted structures in Europe. The average life of uncreosoted docks and bridges is but seven years.

Extensive works for creosoting have been erected at Elizabethport, N. J., Boston, Mass., and Pascagoula, Miss. Others are in contemplation.

I sincerely trust that the result of this presentation of facts, which are undoubtedly new to most of our fellow-citizens, will serve to hasten the time when our commercial marine, as well as our harbor improvements, may be thoroughly armed against both the teredo and decay.

MR. PAGE showed some specimens of the teredo in alcohol, and samples of its work on wood, as well as one piece of timber one half which he had treated by his process, while the other half was in its natural state. This had been exposed under water for several years, and while the unprepared half was freely bored, the other was untouched.

MR. HENRY STEERS: The work of the teredo is the great pest of the ship-builder, and is a subject which I have given some attention. I have treated wood with several preparations, and once sent some piles to Florida where the docking had been destroyed, and a check to the boring of the "ship-worm" seemed most desirable. The wood which I treated was saved, but the expense attending its preparation was so great that it prevented any general use of the remedy. I have labored to interest people in this question, but have found them indifferent to it, even where their interests were greatly at stake in it.

DR. TRIMBULL: It was from the boring of *Teredo navalis* that Brunell got the idea of his tunnel. Its engineering is perfect; it bores its way and securely lines it as it proceeds. Here is some marble which is perforated by the larva of a fly, one of the *Ephemeridæ*, but instead of being bored after the manner of the teredo, its tunnel is accomplished by chemical action—by means of an acid secreted by the larva. A vessel loaded with marble was sunk on our coast some years ago, and upon raising it, it was found to be ruined.

The following paper on the "Reproductive Habits of Eels" was then read by ROBERT B. ROOSEVELT:

At the meeting of the Fish Cultural Society, held February 27th, 1878, I read an article on the generative habits of eels, and then, for the first time, was made public an authoritative announcement of the discovery of their eggs, Prof. Spencer F. Baird stating that he had received, some six weeks previous, several eels in which the eggs were not only visible, but so far advanced as to be nearly ripe for emission. This statement at the time, and without further explanation, seemed to conflict with other well-ascertained habits of these fish. It went to show that they matured their spawn in winter, when they were dormant and em-

bedded in the mud, and when they could not unite with the male. But it subsequently appeared that the parent eels, to which Mr. Baird referred, had been caught in the fall of the year, when they were in full activity, and in the fresh water preparatory to spawning. I believe they were part of those taken by Mr. Atkins in Maine, a locality in which it was probable that the eggs would mature more early than with us.

At the present there is no doubt about the truth of Professor Baird's discovery. The action of this Society and the discussion before it attracted public attention to the characteristics of eels, which for two thousand years had been a stumbling-block to the physiologists. Valuable information came pouring in from all quarters, and although there was, as there always had been, much contradiction as to fact and opinion, important progress was made in our knowledge. The received theories of the descent of the mature fish to the sea in autumn to spawn, and the ascent of the young in spring to the fresh waters to grow were discredited, and if not disproved, are now shown to be at least exceedingly doubtful, or at the utmost local, while their entire method of reproduction is being freed from the strange theories which once surrounded it. It is no longer supposed that eels are hermaphrodite—the two sexes united in one fish—as occurs only with the lower forms of animal life, nor that they produce their young alive, nor that they have more than one heart in their bodies, although we have not yet ascertained accurately where and when they spawn, nor has an impregnated egg or milt, or a living *spermatozoon* been obtained.

The presence of the eggs in the spawning fish was so apparent when the proper part was examined, that it seemed impossible that any difficulty could have ever arisen about it. And it now appears that many investigators claimed to know of the existence of the eggs, and had seen them previously. Notwithstanding these posthumous discoveries and assertions which always appear in such cases, to Mr. Atkins, Professor Baird, and especially to Mr. Eugene G. Blackford, who popularized the discovery and confirmed it, is due the credit of being the first persons who, in the course of two thousand years of experiment, discovered the procreative methods and organs of the

eel. It is gratifying to think that so desirable a result is largely attributable to the action of this Society. In my paper of last year I suggested as a probability that spawn would be found, if at all, in the fall months, just previous to the time when eels hide themselves in the mud in the process of hibernation. Not that this is hibernation in the broadest sense of the word, as the fish are during all of it not absolutely torpid, but perfectly capable of motion if disturbed, and of taking food from time to time. I have seen them when driven from one locality swim rapidly against a strong current with as much apparent ease as in summer, and I learn that on warm days they will occasionally feed. But in winter eels lie dormant if undisturbed, and conceal themselves in the mud whether they happen to be in salt water or in fresh. Of this there is no question, and this hibernation commences in this neighborhood in November and continues till April. My pond on Long Island has been drawn off for three succeeding winters for the purpose of digging out the muck which had accumulated on the bottom, and many grown eels were found in it, and were dug up with the muck. On the same subject I quote an article which appeared in the London *Field :*

"At a meeting of the Wernerian Natural History Society of Edinburgh, in 1841, Sir Walter C. Trevelyan read an account of some tame eels in a small pond in a walled garden at Craigo, the seat of David Carneghle, Esq., near Montrose, where it was stated eels have been kept for nine or ten years. They lie torpid during the whole winter, except the sun is shining brightly, when they will occasionally come out of their hiding-places under some loose stones and sprawl about the bottom of the pond, but refuse to take any food. The 26th of April was the first day in 1840 that they rose for worms, but they eat sparingly until the warm weather begins, when they become quite insatiable; one of them will swallow twenty-seven large worms, one after the other.

"When they were first put in the pond and had no food given them, they devoured one another. They generally lie quietly at the bottom of the pond, except when any of the family go out

and look into it, when they invariably rise to the surface, sometimes for food, and at others merely to play with the hand or to take fingers into their mouths."

And in this connection I will quote the following from the Chicago *Field*, although it bears important testimony on another question of which I shall speak presently :

"How Eels are Caught in Maine. Frank E. Dyer of Belfast, now at South Deer Isle, in charge of an eel-fishing establishment, writes some particulars concerning the business. The fish are sent fresh to New York markets. At South Deer Isle there are two large ponds, three miles inland, which are connected with a creek by small running streams. In the autumn the fish run up through these streams into the ponds, where they pass the winter imbedded in the mud. The run begins the first of September, and ends the last of October. In order to capture them, traps are made and placed in the streams through which the eels pass. These traps are wooden boxes, ten feet long, four feet wide, and two feet deep, with ends made of wire netting. The end in which the fish enter is constructed after the style of the lobster-pot, so that when a fish enters it cannot easily get out. To make the fish enter the trap a dam is built across the stream, the only opening being the mouth of the trap. Some will not enter, but will bore a hole underneath the dam. This is the fisherman's greatest annoyance, having more or less of these holes to close every day. The fish only travel in the night time ; not one is to be seen after daylight. They prefer dark, stormy weather, and on such nights as high as ten barrels are taken from the traps. At high water the fisherman visits his traps in a dory and dips out the catch, which is taken to floating cars in the creek, where the fish are kept alive until wanted. This company has now sixty barrels, or 15,000 pounds of the fish. After the weather becomes freezing cold the catch is prepared for market. The skin is stripped off and the fish is laid straight on a board, where it freezes. They are then packed in boxes and shipped, and often bring from fifteen to twenty cents per pound."

In salt water eels are not taken in pots after the fall months,

but are often speared in considerable numbers through the mud. This is done with a broad spear, a foot across, which is thrust into the bottom without special direction, but in such localities as the fish are in the habit of seeking for hibernation. These places are probably springy, with the fresh water oozing from the bottom and penetrating upward through the mud. It seems, from the article above quoted, as read before the Wernerian Society, that the habits of eels in England are substantially the same as in this country: they are dormant during the winter and begin to move and take food about the middle of April. Here, while the young make their appearance in large bodies by April 1st, the mature eels do not feed, and are not taken in eel-pots until later, and probably have not left their winter quarters. So it would seem either that the eggs are deposited in the autumn, which is probably the fact, or that impregnation takes place, not in the ordinary way, but by bodily connection.

Mr. Atkins, and many other gentlemen, insist that spawning-eels descend the rivers in the fall to the salt water, and point to the construction of eel-weirs as proof; but it is possible that they are not descending, but are only roaming about looking for an appropriate place to spawn. They are caught in weirs late in the season, when the *ova* must be well matured, as was the case with those taken by Mr. Atkins, and just before they hibernate. They would scarcely get to the salt water before they would have to spawn, if they were to do so before hibernating, and yet it is a general rule that fish cannot change instantly from a fresh to a salt water element, or *vice-versa*, and never spawn immediately after making such change. Salmon remain for months in the running streams before they deposit their eggs, and return to the sea with almost equal deliberation. Experiments have been made in the New York Aquarium in moving fish from one of these elements to the other, and although I cannot speak positively about eels, sudden changes killed most varieties. I had long ago ascertained that even minnows could not be taken from salt water and placed in fresh ponds without killing them. If the eels have sufficient vitality to endure the change, it must be a shock to them which would be disastrous at so critical a time as that of spawning.

Mr. Dyer's testimony, quoted above, is positive that eels ascend the streams in the fall, and he points out that they do this in stormy weather, which is a curious statement when taken in connection with the following testimony of Mr. Chalmers, who insists that they descend the streams in the fall, but also says that they do so in stormy weather. It is possible that this idea of their descending in the fall comes from the fact of their moving about at that time, preparatory to spawning, especially as they could easily be taken in nets by being driven down stream, and could not be taken up stream against the current in an ordinary net stretched across the stream. Mr. Chalmers speaks as follows, after first stating that eels always descend in the fall:

"At the first heavy rain and wind-storm of a dark night, on or after the fall of the leaves, and every storm after until frost sets in, he would find eels moving. The harder and darker the night the greater the fisherman's harvest. After the storm clears off and the water begins to get clear, the run stops until the next storm, when the eels move again. By holding the lantern close to the surface of the water you can occasionally see one pass tail first. In the same water we have helped catch several barrels full in a night, and for many nights in a season. We have caught them in early spring with hook in the same stream, as plenty as if an eel had not left there the previous fall. The net will have to be visited at least every twenty or thirty minutes, as we have known nets carried away from side stakes by weight of fish and leaves. Many eels will be found drowned in the net, while others are full of life and vigor.

"THOMAS CHALMERS."

In suggesting these possibilities, I do not mean to say that eels do not breed in the salt water. Bertram, at p. 13 of his "Harvest of the Sea," asserts this very positively, and I know nothing to the contrary, but I do know that they also breed in fresh water, and that on Long Island the young go down stream in the spring as soon as they are hatched. Absolutely mature eggs are yet to be found; for although Mr. Blackford has found

them in various conditions of maturity, and those first discovered by Professor Baird were far advanced, none, I believe, were actually ripe for emission, and until eggs are discovered in this condition we shall be in the dark as to the exact time of spawning. Bearing closely upon this question is the second contingency which I have mentioned, that there may be connection between the sexes of eels instead of the fecundation of the eggs after their extrusion. There is certainly considerable evidence on one side of this question, and as yet none on the other.

Mr. Andrew S. Fuller is reported, in a recently published interview, to have said that "the researches of the naturalists have not yet thrown light upon what are known as 'eel-balls.' Eels, like snakes, link and twist themselves together, forming large clusters or balls. These balls are frequently found in streams during the fall. The clusters are sometimes so large that they roll into mill races and clog the wheels of mills. Pliny speaks of this habit of the eel. He says in the river Mincius, in October, a man may see rolling among the waves a wonderful number of eels wound and tangled one within another, sometimes a thousand of them wrapped together in one ball. The object of their rolling themselves up in this way is a mystery. Mr. Roosevelt is doing his best to fathom it. It would be very interesting to know if all were of one sex, or if both joined in making up the mass. The careful examination and dissection of every specimen in one of these clusters might throw some light upon the relation of the sexes, about which there is still much that is obscure."

The creatures referred to above may not be eels, but if they are the explanation would seem to be that which is intimated by Mr. Fuller, namely, the sexual act. I have never seen this operation, and cannot vouch for it; but other persons, even in this country, have asserted it in the course of the discussions brought out by the investigations commenced by the Fish Cultural Association. No male eels have yet been discovered, that is, no eels containing milt. It has been suggested that the males may be much smaller than the females

and not caught or marketed, and even a difference is supposed to exist in their appearance. But these suppositions are not borne out by proof, and eels are found during the fall with neither milt nor spawn. These may be barren, or spent; but they may also be males, and should be examined anatomically under the microscope to see whether traces can be found of genital organs. This is merely a suggestion, as I have no opinion to offer on so curious a question; but as it is a possibility, it should not be neglected.

I have not referred to an article which appeared lately in a monthly periodical, claiming to have discovered the milt in eels, for the reason that it was so wholly unsatisfactory to me, seeming little more than an attempt to appropriate undeserved credit, and one of those discoveries, as far as it was correct at all, of what had already been discovered. It omitted any reference to Professor Baird's statements, which had been announced some nine months previously, and ignored wholly the investigations of Mr. Blackford, with which the public were familiar through the newspapers. But more than this, the account is confused and unsatisfactory in every particular, assertion taking the place of fact, contradictions being numerous, and the language inaccurate, and at the close the writer admits the uncertainty of his own conclusions, as they are totally at variance with those of Dr. Syrski, who had already shown that what he claimed to be milt, or *spermatozoa*, were merely undeveloped eggs. But leaving anatomical questions to be setttled by others, as fish-culturists we know that eels containing ripe milt have never been seen, and until we can get the milt in that condition it is of no value to us. For our purposes one of the first things to do is to study these fish more carefully at night, which is the time they seem to prefer for many of their movements.

Since the foregoing was written, an article has appeared in the February number of the same periodical, in which it is admitted that the previous statements were an error, and that "the male sex has yet to be discovered" among eels. My conclusions were fully borne out by subsequent investigation. During the month of February, 1879, however, spent-eels have been found in New York market. It could not be determined from

what part of the country these were obtained, so the time of their spawning, as affected by locality, is not certain, but the membrane of the *ovaries* was clearly visible, and was lax and empty, and the extrusion must have been just completed.

Turning to another peculiarity about eels, the fish-culturist will observe that there is one common inconsistency about them. Mature eels can be transported readily, packed in barrels, and will live twenty-four to forty-eight hours without water. They are capable of great endurance treated in this way, although they will not live in stagnant ponds, but the young are exceedingly delicate, and cannot be carried any distance without frequent changes of water. From my experience, I should say they would die as quickly as young trout, although the Michigan Commissioners claim they can be transported in mud mixed with water-grasses. They grow rapidly and feed freely on one another. I have seen salmon fry choked by trying to swallow an eel of two inches in length, and I have opened an eel of nine inches, whose stomach was swelled out into a round protuberance by the number of little eels which it contained. They eat all manner of little fish, and almost any sort of food. The fry when they first appear are like white threads in the water, but in two weeks they are dark on the back and yellowish on the belly. The run of the fry on Long Island begins April 1st, and closes entirely by May 24th. As to their increase in size later in their life, we have the testimony of Mr. Wells, who placed some twenty thousand in a fresh-water pond which had no outlet. In a printed letter to the *Forest and Stream* he makes the following statements:

"RIVERHEAD, N. Y., Aug. 14, 1873.

"I do not know about their spawning. There are other fish, pickerel, pumpkin-seeds, and yellow perch, who may eat the spawn. My eels are so tame that you can hold a horsefoot by the tail just under the water, and all that can get their heads into it will do so. You may catch them in your hands (if you can hold them). They have grown this summer, some from twelve to a pound, to six pounds a dozen, dressed. They gain very fast while feeding. Now they are very fat. They will eat

250 horsefeet, or 15 bushels of soft clams in a night. The next day they will not be seen by any one. I have fed about six or seven thousand horsefeet this summer, at fifty cents per hundred. The pond is a clear sand bottom excepting about three acres in the middle, which is mud, from one to five feet deep; the water is some five or six feet in the middle. Whole pond covers about five to seven acres. The margin is sandy all around. It is a spring-bottom pond. I put twenty-three small eels in the pond twelve years ago. In three or four years they weighed from two and a half to four pounds each, which was the cause of my trying this experiment.

"J. N. WELLS."

So far I have considered this question of the procreative habits of eels on the theory that the eggs are deposited, whether impregnated previously or not, and that they hatch after extrusion. I believe this to be the most natural and altogether the most probable theory; but I cannot ignore a considerable mass of testimony sustaining the idea that the young are born alive. It is barely possible that the eggs are developed in the body of the female in the fall, that they are fertilized by an act of coition with the male, that they are matured during the season of hibernation, that the young issue alive in the spring, the first moment their parents begin to move. There is nothing absolutely inadmissible in this theory when it is tested by the facts which we may regard as established, although for my own part I am not ready to place faith in it. I cannot, however, totally ignore it, and I offer the following statements, taken from a considerable number which have been presented to me. There is an impression in the minds of some persons, who should be well informed, that the lamprey is the female of the common eel; and one of the shrewdest observers of natural history, although not an educated man, gave me his personal evidence to that effect. He said that on one occasion he noticed a lamprey swimming up a small creek in the meadow, with a black fringe hanging to her neck. On close inspection this fringe turned out to be innumerable young eels clinging to her breathing-holes or gills, and his curiosity being aroused, he watched her

further proceedings. She ascended the rivulet till she came to a sandy spot, where she stopped, and the young immediately left her and squirmed their way into the sand out of sight. After they had disappeared she dragged stones over the spot, using her mouth for the purpose, till it was entirely covered. Then she left it, and my informant immediately proceeded to dig it up and remove the young eels, which he found there as he expected. The most remarkable fact, however, was that he was positive that a large proportion of these young were common eels, he assuring me that he could distinguish the difference in the mouths perfectly. In this he may have been mistaken; but, from his description the parent must have been a lamprey, and it may be that the lamprey alone is viviporous He also said, what I already knew and had stated, that the color of eels is no indication of their sex, but is determined by the nature of the bottom and water where they live. Eels that remain in fresh water become golden yellow on the abdomen, while those that live on a sandy bottom in a salt tideway are so light-colored as to be designated "silver eels." This is important to those investigators who would distinguish the sexes by their color.

I should give little weight to these statements were I not aware how close an observer of the habits of wild creatures my informant was. His opinions are further endorsed by the strong assertions contained in the following letter, which I have lately received from Mr. Wells, the gentleman already referred to as having raised eels in a pond on Long Island:

"RIVERHEAD, N. Y., Jan. 27, 1879.

"*Dear Sir:* Yours of 18th received. In reply I state the following facts: My pond has no outlet commonly, but sometimes, in very high springs, the water runs to the river some quarter of a mile through the woods in the valley. The distance is about two miles to Riverhead, the head of the bay or salt water. My pond is supplied by the springs the same as a well, and when the springs are low in the well they are the same in the pond. As to the eels spawning, I can say I have seen the young just spawned. I have put the mature ones in a barrel at night, and in the morning there were numbers of young eels about as

large as a No. 3 needle, perfectly white, with the perfect form of eels. Last spring Mr. William Downs, an old eeler, told me that finding small eels by the quart in his box while he was salting the old ones, and never having seen anything of spawn in eels to know how the young came, he made up his mind to find out. He was skinning the eels, and did as others do, and saw nothing; he then began to examine the entrails; in cutting these open he found a small sack or bag, in which he saw the young sticking their heads out. He examined several eels until he was satisfied about one-half were she-ones, as about one-half had small eels in them, and the others none. I have got information from others to corroborate the above facts, but a man may dress eels his life time and not see one, because he does not look in the right place. They spawn or hatch the last of April or the first of May; they lay their young in springy places in the sand, or in the fresh water around the bays or creeks, and always find as fresh or brackish water as they can. They will spawn in a pond if there is any way for them to escape from being devoured by other fish or large eels. I could give you more proof of the above if I had space. Eels generally go into the mud when the weather becomes cold, but if there is a warm day or spell they move about. The common eels "mud," or go under the meadows in holes, by thousands together in salt water. Eels start in spring as soon as the weather is warm, say the middle of March or first of April, according as the weather may be, and about the middle of April they come out of the meadow. You will not get any out of the mud unless by the spear. They bed anywhere that there is mud, in large bays, rivers, creeks, or ponds. My pond has a sandy bottom, and is surrounded by woods; the shore is sand and the mud begins some three to five rods from the shore. The water, which is clear, then deepens till it is some six feet deep in the middle. If you will come here next May or June I will show you the greatest sight you ever saw. The eels then come like a flock of young ducks to a pan of bran. You can throw them away with your hand and they will come right back. I don't want any young eels in my pond, so I keep fish to eat them up. They spawn like a sow has pigs, which I will prove next May, for

one thousand dollars, or forfeit that sum. If they are fed well they will grow fast, if not fed well they will not grow at all. They will grow in three years to weigh four pounds a piece, from one-twelfth of a pound to start with.

"Yours, &c.,

"JAMES N. WELLS."

I have, in the foregoing pages, given the best testimony and evidence as to the procreative habits of eels that I could obtain, even at the risk of repeating a part of what had already been published. The contradictions are positive and apparent, and there is room for much further study and investigation. We have, however, made a decided advance in our knowledge. We have found the eggs. We are sure these mature in the fall or winter. We know that the young appear in spring, and must be born during the winter. We are getting further insight into the habits of these curious creatures; and having aroused the public attention, we shall undoubtedly soon ascertain the actual facts in all their necessary detail. If we have not learned all that is needed by the fish-culturist, we have at least discovered the foundation for requisite protective legislation, can enact laws intelligently for the protection of a fish which is of considerable economic value in many parts of the country, and which is, like so many other of our fishes, rapidly diminishing in numbers.

MR. GREEN: I would like to call attention to the young whitefish which I have seen in the markets sold as herring. Now, some folks have got an idea that every fish as big as a herring that looks like a herring is a herring. Now, here is a young whitefish (showing a cooked one) which I brought down from my hotel, which I got when I asked for herring. There is a difference in the bones of a whitefish and a herring, and this is a whitefish. If this fish had lived another year it would have weighed two pounds, and have made a dinner for several men. They fish with nets having too small a mesh. I object to the destruction of small fish. Here is Mr. Theodore Reinecke, a man owning pound-nets, who will tell you the same.

MR. REINECKE: Fish are getting scarcer, and if they continue to decrease at the same rate for the next ten years, they will be a luxury, instead of food for the people. I hope that something may be done to stop the sale of small fish in the market. I will make the meshes of my nets five inches. (Applause.)

MR. GREEN: I never heard a pound-netter talk so before.

MR. HALLOCK: Here is a piece of pumice thrown up by volcanic action in the Gulf of Mexico, where fish have been killed by the thousands by a submarine volcano, and the fishermen impoverished in consequence. The same thing occurred in 1853. The eruptions are intermittent.

MR. A. S. FULLER sent a specimen of the belestoma, which was examined by the members, and declared by Mr. McGovern as identical with the one which he found attacking his trout.

MR. TRIMBLE, said he had seen eels going up Fairmount Dam at Philadelphia, and in the spring young eels can be seen in countless numbers in the eddies for a distance of one hundred miles above.

A member asked what was the smallest eel ever found, but no one semed to know.

MR. ROOSEVELT: There would seem to be a difference in the spawning season of eels in different localities. Long Island appears to form an exception in this respect.

MR. BLACKFORD here exhibited a large eel with full ovaries.

MR. GREEN: If this is spawn it is what we have always called "eel-fat." There are no eels above Lake Ontario except those which have been placed there.

MR. CONSELYEA: Young eels are plentiful in Long Island streams in April, and can be seen in swarms at that time.

MR. ROOSEVELT thought that eels move at night.

MR. BLACKFORD: We have found spawn in eels since October, always more or less developed. About the 1st of December last Mr. Fred. Mather measured the eggs of a six-pound eel, and estimated their numbers at nine millions. That eel was caught at Gravesend, Long Island. The eel shown here to-day came from Cape Vincent, near the head of the St. Lawrence river. I think it highly probable that the male eels are small, and that if Mr. Roosevelt had all the facilities which Fulton Market affords, he would most likely have found them.

MR. FREDERICK MATHER read the following paper on the Management of Public Aquaria, with a plan for reducing their running expenses:

In the practical working of a large public aquarium it is found that the well-known principle upon which parlor-aquaria are kept, known as the "self-sustaining" principle of organization by means of plant-life, is deficient in furnishing a sufficient quantity of oxygen to completely consume all the feculent matter, and to sustain the large specimens and numbers of animals required to be shown. Another reason is that there are some forms of life which refuse to live in still-water, no matter how well it may be supplied with oxygen. In fresh water this is seen in the salmon family, some of the percoids and brook-cyprinoids, while in a self-sustaining marine aquarium there are but few fishes that will live.

Two modes then remain as at all possible for an aquarium built upon a large scale, viz.: The introduction of air by means of an air-pump, and the circulating system. The former of these methods is only fit for a temporary exhibition, and even then requires great care and cleanliness or the fish will not thrive even for a few days; and in this I found my views corroborated by the experience of the oldest and best aquarium-keepers in Europe, most of whom have entirely abandoned the use of air-pumps as the cause of more harm than good. The great Brighton Aquarium has a combination of methods, the sea-water being pumped from the sea into reservoirs and then distributed; at the same time a system of air-pipes is relied on for æration as the water is kept until it gets cloudy, and then

is furnished anew is clear at times, and at others cloudy. I may as well here explain that sea-water, no matter how clear it may be when procured, will become so clouded within a week that a person cannot see in it to the extent of a foot. This is caused by the organic matter which, if the water is circulated, will, in time become burned up and deposited upon the bottom of the reservoirs in the form of harmless sediment, say in from one to three months, or even longer, before the water becomes beautifully limpid and of the highest transparency. It is after this purification that plants begin to grow and beautify the hard lines of the rock-work; and in my opinion, the water in a marine aquarium should be circulated for six months in a dim twilight before a fish is placed in it. One of the worst things to contend with in a public aquarium is the light, which, however necessary for the people who visit it, is very detrimental to the fishes.

In speaking of aquarium-keeping, I will say that I would not include in this term any system in which the entire stock required renewing every three months, as there are many fishes which are quite well adapted to aquarium life, and who will thrive there if the tanks are properly kept.

Although aeration by circulation is the proper and only correct method for public acquaria, the aid of vegetation is not to be despised, and marine vegetation is somewhat difficult to grow; yet if the rock-work is so arranged as to give light and shade, and even gloom, in places, the plants which would thrive will appear of themselves, their spores being everywhere in sea-water. The green algæ (*Chlorosperma*) will come in the lighter parts, while in the obscure places those most delicate "red-weeds" (*Rhodosperma*) may grow. If, however, it is thought best to introduce these plants it will be found that most of them will die, as before they get fairly settled in their new home the stimulus of the light will have covered them with green or purple filamentous weeds, as conferva, oscillatoria, etc., which conceal them with their abundant growth, and finally smother them. The mullets (family *mugilidæ*) are the only good vegetable-eaters among our marine fishes which thrive in aquaria, and with the vegetable-eating mollusks, which may be carefully in-

troduced, are beneficial in keeping this growth down to some extent, but are as likely to eat the plants which they should not as all other things are to work against our wishes.

The well-known Venus, ear, *Haliotis tuberculata*, is a favorite in English tanks, and eats conferva clean, and in the two best aquaria in that country the tanks are never cleaned on the inside, yet they look as if that operation had just been performed.

In a French book on acclimatization, by H. de la Blanchere, it is stated that the more the plants belong to the inferior organisms the greater their oxygenating power, and that cryptogamic plants have a greater power of vivifying water on account of their greater evolution of oxygen, and also that M. St. Hilaire has found that conferva in the aquarium of the Société d'Acclimatation in Paris produces a constant and enormous evolution of oxgen.

Such is the influence of light upon vegetation that in my own fresh-water parlor-tanks I have found it necessary to shield them at night during the periods of full-moon in order to check the growth of conferva, and in a public aquarium it is hardly possible to have it too dim for the well-being of the inhabitants, few of whom live in strong lights. No more light should be allowed than that which comes through the water, as then the visitor, standing in obscurity, can readily see what would otherwise be indistinct; hence all attempt at ornament or display outside the tanks is useless.

These remarks, so far, have been intended more for those unfamiliar with the subject, and really contain little that is new to the few who have studied it closely; but in order to render what I intend to say intelligible to the former class, I wish to add the well-known fact that in aquarium-keeping, the longer the water is used the better it is, and that the introduction of new, or fresh water, is often fatal. To sum it up in the fewest words, there is not a drop of new water in the world; it has been breathed over and drank over millions of times; the sun draws it up to a certain height only, and it is blown over the land and precipitated in rain, and then returns to the sea. An aquarium, such as I am describing, is a miniature world; the reser-

voirs represent the sea, the pump is the sun, the pipes are the clouds which convey the water where it is required, the spigots represent the rain, and the overflow-pipes are the brooks and rivers, which return the water to its starting place. And as fish only need water to keep them moist, and their gills free to absorb the oxygen contained in the water, therefore what they require is water supplied with fresh oxygen, which is fresh water.

With these explanations I will now give my idea of constructing an aquarium upon a new plan, the advantage of which is its economy. First, I would aerate the water by flowing over a shallow bed between the tanks, and then introduce it into the bottoms of them, that is, in at the bottom and out at the top, then over another wide, shallow space, and down an aperture to the bottom of the next tank. It takes but the slightest contact with the atmosphere for water to absorb its fill of oxygen, if spread out and exposed; a flow of a foot in length by three feet in width, with a depth of half an inch, would be all sufficient.

The object of this is economy of water, hence economy of motive-power, and was suggested while studying the working of Williamson's "double riffle" hatching-trough.

In all aquaria, as at present arranged, there are small pipes supplying each tank, and the tanks flow into each other, the second one getting all that flowed into the first, in addition to its own stream; while the tenth in addition to being furnished with as much new water as the first one received, gets all that has passed through the other nine. It is evident that if the water is properly aerated after leaving tank No. 1, it is as good as new for the next one, and so on, making a saving in a row of ten tanks of nine-tenths of the water, and consequently of the power required to raise it. Second, The aquarium at Southport, England, has an elevated reservoir, into which the water is pumped from the lower ones and then flows into a few of the show-tanks, and the curator, Mr. Long, remarked that if it was large enough to contain a supply for a week it could be filled in one day, and then the engine might rest.

Combining this idea with the former one there, seems to be

no objection to building an aquarium with an elevated reservoir (in addition to the lower one), and by using the aerating principle given before, saving nine-tenths of the fuel and labor required to run a set of tanks, as is now done, by pumping night and day.

The main difficulty would seem to be the high temperature to which an elevated reservoir would be exposed during the summer. This might be fatal unless it could be overcome by natural advantages, as in case of a hill, where the reservoir might be placed in its side, or if connected with some institution which could combine an ice-house with its elevated reservoir. It has seemed almost impossible to sustain a public aquarium without the objectionable features of what are known as "additional attractions," and yet it should not be. There are a few aquaria which are managed without these, as the one at Southport, the Crystal Palace Aquarium, and the pretty little one in Hamburg. These have not even music to disturb one's thoughts, and an aquarium, proper, should not have. These aquaria, however, are situated in the midst of other attractions, and require an additional fee from the visitor, the first named being in the Winter Garden, the second in the Crystal Palace, and the third within the Zoological Garden.

I have long hoped to see an aquarium built in America which would be conducted upon correct scientific principles, and in which men of science could become interested. Such an institution would not only be valuable to the public as an educational medium, but also to fish-culturists and scientists as a place for experiment.

MR. PHILLIPS moved for an amendment to Article 3 of the Constitution, so as to include a Recording Secretary, which was carried.

THE PRESIDENT announced that the nomination of officers for the coming year was now in order, and appointed as a Nominating Committee, Mr. Charles B. Evarts, Mr. Seth Weeks, and Mr. George E. Ward.

A recess was then taken.

When the meeting was again called to order the Committee nominated the following officers, who were duly elected:

President—ROBERT B. ROOSEVELT.
Vice-President—GEORGE SHEPARD PAGE.
Treasurer—EUGENE G. BLACKFORD.
Corresponding Secretary—BARNET PHILLIPS.
Recording Secretary—JAMES ANNIN, JR.
Executive Committees—FREDERICK MATHER, BENJAMIN L. HEWITT, G. BROWN GOODE, SAMUEL WILMOT, BENJAMIN WEST, THEODORE GILL, and THOMAS B. FERGUSON.

No alteration was made in the appointments to the Sections as organized last year, and which were as follows:

SECTION 1.	Mr. S. Green, Mr. S. Wilmot,	*Methods in Fish Culture, etc.*
SECTION 2.	Mr. C. B. Evarts, Mr. L. Stone, Mr. T. B. Ferguson,	*Fishery Laws and Fishways.*
SECTION 3.	Mr. J. W. Milner, Mr. F. Mather, Mr. C. Hallock,	*Natural History, Aquaria, etc.*
SECTION 4.	Mr. E. G. Blackford, Mr. B. Phillips,	*Fisheries.*

THE PRESIDENT called attention to a new illustrated work on the "Game Fishes," about to be issued by Charles F. Scribner's Sons, New York, the chromos being after oil paintings by S. A. Kilbourne, and the text by Prof. G. Brown Goode, of the Smithsonian Institution.

MR. BARNET PHILLIPS then read the following paper on Prehistoric Fish Hooks, exhibiting a collection of bronze hooks, &c.

I do not think I am making too much of a divergence from the general topics brought before the notice of the Association, when I call your attention to some implements of fishing in use say three or four thousand years ago.

I have had very kindly loaned me by Mr. Feuardent, a whole collection of bronze hooks, coming from recent discoveries in the Swiss lakes, the fishing relics of a pre-historic people.

As may be seen, when I shall pass these hooks among you for examination, you will be surprised to find that the shapes of some of them are precisely like those of the hooks of to-day. If my memory serves me rightly, there is one large hook, about as large as a cod-hook, which resembles exactly in make the Norwegian hooks I examined at the Centennial Exhibition, save that the shank in the pre-historic hook is square.

The metal employed is bronze. Of course the presence of hooks carries with it the idea of a line made either of hemp or flax. The fish of the Swiss lakes were possibly fairly large, if we consider the size of the biggest hooks. The Geneva trout was, however, hardly bigger than he is to-day, for it is not likely that in the brief period of four thousand years the species varied very much. The time between then and now was too brief for any possibility of natural selection.

Dwelling but for an instant on the fact that the largest hook resembles the Norwegian ones, the question arises, where did the metal come from?

From what country did the Lacustrine men derive their copper and their tin. Was it from Britain? It is natural to suppose that merchandise always follow the shortest route. Could bronze have come through from the eastward overland? Archæologists are prone to think that tin found its way in early times into Europe from even far-distant Malacca. Did bronze then travel as precious metal from the Indies, slowly making its way across the Ural Mountains, passing from hand to hand as gold does to-day, until at last it became the prize of some long forgotten, lone fisherman, who tried his luck in a Swiss lake? The archæological studies lead the student into some very blind passes. Now, these Lacustrine people possessed some really beautiful tools, jade chisels set into the horns of deer. Now, where did the jade come from? There is certainly no jade in Europe, save beyond the Ural Mountains, and in farthest China. Was there intercourse between China and Switzerland, and was the possessor of a bit of jade or a bronze fish-hook considered as

he would be to-day, the lucky possessor of the Kohinoor diamonds? Let us then suppose that the Lacustrine fisherman who lost this hook in the Bienne Lake, was a dilettanti sportsman, as nicely equipped as would be to-day say a swell-member of the Southside Club. The hook I have called your attention to has a flange to which the line was tied. The bend of this hook is quite perfect, and the turn or draft so well devised as to throw the point of the barb in the line of the hauling. The principle of fishing with a hook, then, was thoroughly understood. You will find among the hooks the regular pin-hook. It may have belonged to the Lacustrine small boy, who stole a hairpin from his fond mother, and giving it an artistic bend, played truant, and went bobbing for eels. Maybe there was a pre-historic Seth Green, who invented then a barbless hook.

These Lacustrine people, who lived in houses built on piles on the Swiss lakes, must have been essentially a fishing-people. If they did not enjoy the benefits of a Fish-Cultural Association, they possibly knew quite as much about the propagation of eels as we do.

You will observe that some of the hooks are double, just as we make them to-day. In fact there is nothing new under the sun, not even perhaps the famous sockdolager hook.

In calling to your notice the fishing implements used in past ages, I can show you what is supposed to be the earliest device for catching fish yet known. It is the most primitive of all snares. This is a piece silex, double-pointed, belonging to the neolithic age. The cord was tied in the middle, and when baited the fish swallowed it and was gorged. As to its age, I should be afraid to state it. Possibly it caught fish long before the alluvium covered certain portions of Switzerland, maybe before Europe and Africa had no Strait of Gibraltar to let out the Mediterranean Sea. This method of catching fish by a cross-piece is not yet entirely out of use. M. de la Blanchere tells as that in France a similar form of instrument is used for catching eels. A straight piece of elder is taken, a needle pointed in both sides is passed through it; this is baited, and so eels are caught. You see what an important role eels play in the history of the world.

American fishing implements of former periods are rare. I know of but one hook, which figures in Mr. Charles Rau's publication, issued by the Smithsonian Institution. This hook, which was of bone, was found at Santa Cruz, California. It has traces of asphaltum sticking to it where the line was secured. The peculiarity of this hook is that the barb is outside, not inside, of the bend. It resembles very closely the hooks used by the natives of Polynesia. Bronze hooks, or in fact any instruments of an alloyed metal, have not been discovered on the American continent. All such implements as have been found are made of pure copper. There are certain forms of stone, round disks, with a hole pierced through them, which might have served as sinkers for nets or lines; but as they may have been used for ornaments as pendants, or for wearing, it is doubtful whether they were employed in fishing.

I shall conclude this most brief notice by asking you to look at a barbed bone, a harpoon in fact, coming from a cave in France. This belongs to an age not as old as the stone period, following it, however, but immensely remote from the bronze era. I could not pretend to give you its age, any more than I could the flint of the stone period. What is curious about this harpoon-head, is that it is precisely like the bone implements found in Indian graves in Michigan and Alaska, and is the counterpart of the bone-harpoon in use to-day by the Esquimaux. Thinking over the discovery of such bone-harpoons in Switzerland, in Dordogne, in France, we cannot but help arriving at other deductions. If hooks were used for fish, these harpoons certainly were not. These hooks are implements which served man's purposes but yesterday—a yesterday of four thousand years distant, it is true; while these bone-harpoons were employed to impale creatures which do not exist to-day in the localities where these weapons were discovered. Seals and cetaceans, huge animals, marine or terrestial, certainly abounded in the former country, which bore more resemblance to Greenland than it did to the Switzerland or France of to-day.

I have been necessarily brief in referring to these old hooks of stone, bone, and metal. But see, by means of them, what a vast extent of time, long gone past, we pry into. These imple-

ments, strangely enough, lead us back to the natural history of an unknown period. The ichthyological glimpses, it is true, are but faint; still it may not be impossible, by their study, to follow farther back the structures of fish as first developed by the fossil forms. If nothing else, they help us turn over an additional leaf in the history of man and his surroundings.

As there is no patent on any of the forms of hooks, gentlemen wishing to copy any of them for bass-fishing, may do so with impunity, as the Lacustrine man is not likely to enter a caveat.

MR. THOMPSON spoke on the California salmon. He had received many eggs from Prof. Baird, and had tried for several years to raise them in confinement, but they did not grow well. He had made a dam across a ravine, flooding from sixteen to seventeen acres, to a depth of twenty-five feet. This pond was fed by springs. They take a fly well, and are growing, and although ripe males have been taken, no ripe females have as yet been found.

MR. FREDERICK MATHER then read the following paper on "Recollections of the early days of the American Fish Cultural Association, with an account of the intentions of its founders:"

Although but eight years have passed since the formation of our Association, there have been so many changes in its membership and place of meeting, together with a poverty of the early records, that as one of the founders of the Society I have been requested, in view of the brilliant future which is believed to be before the Association, to give a sketch of its early history and the causes which led to its formation. Such a sketch must, of necessity, partake largely of a personal character, for it is of course impossible to define the intentions of others, but it is proper to say that for myself I had no idea of a large and influential organization, with the character and scope of the present American Fish Cultural Association growing out of it, but only contemplated the possibility of establishing a scale of prices for trout-eggs and fry among those who at that time were dealing in those articles, and so prevent a ruinous competition.

During the summer of 1870 I had frequent interviews with Mr. A. S. Collins—who was then breeding trout on Caledonia Creek, where the New York State Hatching Works now are—on this subject, and as my own ponds were only fifteen miles east, at Honeoye Falls, we had frequent conversations on the subject. I also had several letters from Dr. J. H. Slack, who likewise wished a protective organization. Mr. Collins did not enter so readily into the establishment of a scale of prices, as he had more eggs than either, or perhaps all of us, and more than he found ready sale for; still he favored an Association, which was formed, but the idea which was entertained in a greater or less degree by Dr. Slack, and wholly by myself, never was adopted by the Society.

In October, Dr. Slack wrote that he had corresponded with Mr. Livingston Stone, of the ponds at Charlestown, N. H., and Mr. William Clift, of Mystic, Conn., and they were inclined toward an organization. On November 1st, 1870, a call was issued in several newspapers for a meeting of practical fish-culturists, to be held in New York city on the 20th of December.

This call was signed by W. Clift, A. S. Collins, J. H. Slack, F. Mather, and L. Stone. The place of meeting was the rooms of the New York Poultry Society, where a temporary organization was formed, with W. Clift as Chairman, and Livingston Stone as Secretary.

Dr. M. C. Edmonds and Mr. Stone were appointed to draft a constitution, which upon presentation was adopted, and the following officers elected for one year: William Clift, President; Livingston Stone, Secretary; Benjamin F. Bowles, Treasurer.

Nothing more was accomplished at this meeting, and it adjourned to meet again at Albany, in connection with the annual exhibition of the Poultry Society, nearly fourteen months later, on February 7th and 8th, 1872.

This meeting at the Globe Hotel, on the corner of State and Pearl streets, Albany, was the first annual meeting of the Association, and deserves to be recorded as one of the most important in its history, as during the first day's session Mr. George Shepard Page introduced a resolution that a committee be appointed to draft and present to Congress a memorial, ask-

ing for the erection of two or more fish-hatching establishments: one for salmon near Puget's Sound, and the other at some point on the Atlantic coast. This was, I think, the first move toward making fish culture a national institution, and its fruits are seen to-day in the reports of the United States Fish Commission, showing the great amount of work done, not only in our own country, but also having a system of fish exchanges established, whereby in return for what we have in plenty we obtain the most desirable of European fishes for our own waters.

The second annual meeting was held at the office of Mr. George Shepard Page, No. 10 Warren street, New York, on Tuesday, February 11, 1873, and was distinguished by the fact that Prof. Baird's report, as United States Fish Commisioner, in which he gives full credit to our Association for making the first movement in obtaining an appropriation from Congress, was read in full before it and warmly applauded.

At this meeting Mr. Stone resigned the position of Secretary, and Mr. A. S. Collins was elected to succeed him, the other officers remaining as before.

The third meeting was held at the same place on Tuesday, Feb. 10, 1874, when Hon. Robert B. Roosevelt was chosen President, and Mr. George S. Page Vice-President, with Mr. Collins as Secretary, and Mr. Bowles as Treasurer. Although this meeting was well attended and many interesting papers read, there were no great events of importance to record which would raise it above its fellows, as in the case of the two previous ones.

The fourth meeting, on Tuesday, February 9th, 1875, was also held at the office of Mr. Page, and the same officers elected. Mr. Eugene G. Blackford and Prof. Baird both spoke in favor of the establishment of a public Aquarium in New York, by a joint-stock company, as instructive and profitable, and the Association passed a resolution expressing their "belief that an Aquarium in the city of New York would be a great benefit to science generally, and ichthyology in particular, and giving its favorable countenance to any public or private measure in that direction."

There is reason to believe that this also brought forth fruit, in the establishing of one by private enterprise, in which the As-

sociation was so much interested as to change its place of meeting to the Aquarium in 1877; but a change in the management of the Aquarium so altered the tone of the institution that only one meeting was held there; and judging from the advertisements in the newspapers, the Aquarium in now almost wholly given up to shows of various kinds, with little or nothing to interest lovers of fishes.

The fifth annual meeting, on February 8th, 1876, was also held at the office of Mr. Page, and the same officers elected, with the exception of the Secretary and Treasurer, Mr. E. G. Blackford taking the place of Mr. Bowles, and Dr. Edmonds that of Mr. Collins. At this meeting it was resolved to hold an extra session at Philadelphia during the Centennial Exhibition, and Prof. Baird was requested to obtain a place in the Exhibition Building for this purpose. Another step in advance was the resolution to employ a stenographer at future meetings, and report the discussions, as well as the papers read, as these were often of as much value as the latter.

This brings the history down to the Centennial meeting, from which point the records have been kept in full, and reports of which are still in plentiful existence.

Since the above was written, a reply to questions asking for information, on the history of the Association, and the objects of its founders, has been received from Mr. Stone, as follows:

COLD SPRING TROUT PONDS.
CHARLESTOWN, N. H., February 13, 1879.

MR. FRED. MATHER:

Dear Sir: I cannot tell you how sorry I am that business of an important nature calls me away to Boston to-morrow, and that consequently I shall be obliged to give up writing any reminiscences of the organization of the A. F. C. A., which you have so kindly invited me to do.

In regard to the primary object of the gathering at New York, in 1870, which you inquire about, I am inclined to think, as you suggest, that it was merely to form a union, like those of other branches of industry, to protect fish culturists in their

business, and to check the decline in prices of fish culturists' products, which was then going on very rapidly, and which foreshadowed the disastrous results to the business which soon after followed. As soon, however, as the first annual meeting of the Association was held, it was apparent that its future efforts were to be directed to the promotion of the public good rather than to the furtherance of private interests. This happy change was at once cheerfully accepted by all, and the subject of regulating the tariff of prices was only once mentioned, I believe, and then dropped forever.

I shall be unable to attend the meeting of the A. F. C. A. this year, but hope to next year.

Very truly yours,

LIVINGSTON STONE.

As the opinion of Mr. Stone on the original idea of the founders of the Association fully accords with the views expressed in the beginning of this paper, it is gratifying to note how soon these views began to expand and leave the original narrow plan entirely, until it gradually passed into oblivion.

With its record of usefulness in the past, when with but a few members it struggled into existence as a sort of an appendage to a Poultry Breeders' Association (now no longer in existence), who is able to forecast its future when its membership is tenfold its present numbers, and when it is publicly acknowledged to be, what its friends now consider it, one of the most useful, honorable, and public-spirited Associations in the world?

Mr. Annin showed a box with flannel trays, on which he had brought spawn to Connecticut a day or two ago.

Mr. Mather exhibited a photogram of one of the boxes in which he took half a million of salmon-eggs to Europe last October.

A resolution was offered returning thanks to the Fulton Market Fish Mongers' Association for the use of the room, which was readily endorsed.

MR. PAGE: The German Fishery Association, of which I am a corresponding member, will hold a Fishery Exhibition in Berlin in 1880, to which the whole world is invited, and I will be pleased to give all information desired by persons wishing to exhibit, and would ask the press to call particular attention to it.

On motion, the meeting adjourned to meet again in March or April, 1880, at the call of the Executive Committee.

CONSTITUTION.

ARTICLE I.—Name and Objects.

The name of this Society shall be "The American Fish Cultural Association." Its objects shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success; the interchange of friendly feeling and intercourse among the members of the Association; the uniting and encouraging of the individual interests of Fish Culturists, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.—Members.

Any person shall, upon a two-thirds vote of the Society, and a payment of three dollars, be considered a member of the Association, after signing the Constitution. The annual dues shall be $3.00.

ARTICLE III.—Officers.

The officers of the Association shall be a President, a Vice-President, a Corresponding Secretary, a Recording Secretary, a Treasurer, and an Executive Committee of seven members, and shall be elected annually by a majority of votes; vacancies occurring during the year may be filled by the President.

ARTICLE IV.—Meetings.

The regular meetings of the Association shall be held once a year, the time and place being decided upon at the previous meeting.

ARTICLE V.—Changing the Constitution.

The Constitution of the Society may be amended, altered, or repealed, by a two-thirds vote of the members present at any regular meeting.

TREASURER'S REPORT.

DR. *American Fish Cultural Association in account with Eugene G. Blackford.* CR.

1878.			
Feb'y 27,	*To balance as per account rendered,* -	$123 50	
March 2,	*To cash paid John M. Davis, Printing,*	66 14	
15,	" " *for Reporting Fish M't Meeting,*	25 00	
27,	" " *John M. Davis, Printing,* -	182 76	
Oct'r 14,	" " *Postage and Wrappers,* -	7 04	
1879.			
Jan'y 28,	" " " *on package from Mr. Edmonds*	55	
Feb'y 10,	" " *for Postage,* - - -	35	
17,	" " " -	91	
		$406 25	

By Membership Fees from last Account to date, -	$174 00	
Due Treasurer, -	232 25	
	$406 25	

New York, February 25th, 1879.

MEMBERS

OF THE

AMERICAN FISH CULTURAL ASSOCIATION.

Ambler, Andrew S., Danbury, Conn.
Andariese, C. H., Bedford Avenue, Brooklyn, N. Y.
Andersen, E. J., Trenton, N. J.
Anderson, A. A., Bloomsbury, N. J.
Annin, James, Jr., Caledonia, N. Y.
Baird, Spencer F., U. S. Commissioner of Fish and Fisheries, Washington, D. C.
Benjamin, Pulaski, New York.
Benkard, James, New York.
Betteman, C. G., Greenville, N. J.
Blackford, E. G., New York City.
Boardman, H. G.
Boyer, B. Frank, Reading, Pa.
Bradley, Richards, Brattleboro, Vt.
Brewer, J. D., Muncey, Pa.
Bridgman, J. D., Bellows Falls, Vt.
Brush, G. H., Norwalk, Conn.
Burges, Arnold, West Meriden, Conn.
Bush, John T., Niagara Falls, Canada.
Campbell, Anthony, Brooklyn, N. Y.
Carey, H. T., 29 New Street, New York.
Carman, G., New York.
Chandler, F. J., Alstead, N. H.
Chappel, George, New York.
Chase, Oren M., Detroit, Michigan.
Chrysler, Gifford W., Kinderhook, N. Y.
Clapham, Thomas, Roslyn, L. I.
Clapp, A. T., Sunbury, Pa.
Clift, William, Mystic Bridge, Conn.
Colburn, Charles S., Pittsfield, Vt.
Collins, A. S., Caledonia, N. Y.

Comstock, Oscar, New York.
Conklin, William A., Central Park, New York,
Conselyea, Andrew, Springfield, Long Island, N. Y.
Coup, W. C., New York City.
Crocker, A. B., Norway, Maine.
Cox, Townsend, New York.
Develin, John E., 155 Broadway, New York.
Dieckerman, George H., New Hampton, N. H.
Edmunds, M. C., Weston, Vt.
Evarts, Charles B., Windsor, Vt.
Farnham, C. H., Milton, N. Y.
Farrar, Benjamin, St. Louis, Mo.
Fearing, C. I., 30 Broad Street, New York.
Ferguson, T. B., Baltimore, Md.
Fliess, W. M., New York.
Gilbert, E., 273 Pearl Street, New York.
Gill, Theodore, Washington, D. C.
Goode, G. Browne, Washington, D. C.
Green, Seth, Rochester, N. Y.
Hall, G. W., 16 West 24th Street, New York.
Hallock, Charles, New York City.
Haley, Albert, New York.
Haley, Caleb, New York.
Harris, J. N., New York.
Hessel, Rupolph, Washington, D. C.
Hewitt, C. L., Holidaysburg, Pa.
Heywood, Levi, Gardner, Mass.
Hilmers, H. C., 63 Wall Street, New York.
Holberton, W., 65 Fulton Street, New York.
Holley, W. P., Katonah, N. Y.
Hooper, H. H., Charleston, N. H.
Hunt, J. Daggett, Summit, N. J.
Hunt, N. W., 70 Lee Avenue, Williamsburgh, L. I.
Hunt, Luther B.
Huntington, Dr., Watertown, N. Y.
Hutchinson, Chas., Utica, N. Y.
Janney, J. L., Newton, Bucks Co., Pa.
Jerome, George H., Niles, Mich.
Jewett, George, Fitchburg, Mass.
Johnson, S. M., Warren Bridge, ~~N. H.~~ Boston Mass
Kelley, P., New York.
Kent, Alexander, Baltimore, Md.
Kingsbury, Dr. C. A., 1119 Walnut Street, Philadelphia.
Laird, James H., New York.
Lamberton, Alexander B., Rochester, N. Y.

Lamphear, George, New York.
Lawrence, G. N., 45 East 21st Street, New York.
Ledyard, L. W., Cazenovia, N. Y.
Lees, Edward M., Westport, Conn.
Lewis, C. A., Washington Market, New York.
Lowrey, G. P., Tarrytown, N. Y.
Lowrey, J. A., Union Club, New York.
Lyman, Theodore, Brookline, Mass.
Maginnis, Arthur, Stanhope, Pa.
Malcomson, A. Bell, Jr., New York City.
Mann, J. F., Lewiston, Pa.
Mather, Fred., Newark, N. J.
McGovern, H. D., Brooklyn, N. Y.
Middleton, W., New York.
Miller, S. B., New York.
Miller, Ernest, New York.
Milner, James W., Washington, D. C.
Morford, Theodore, Newton, N. J.
Morgan, John B., 85 Broadway, Brooklyn, N. Y.
Mull, B. E., New York.
Mullaly, John, 114 White Street, New York.
Neidlinger, Phil., New York City.
Newell, W. H., San Francisco, Cal.
Page, George S., New York City.
Parker, Wilbur F., Meriden, Conn.
Paxton, E. B., Detroit, Mich.
Phillips, B., Brooklyn, N. Y.
Porter, B. B., Colorado.
Price, Rodman M., New Jersey.
Redding, B. B., San Francisco, Cal.
Redding, George H., Stamford, Conn.
Redmond, R., 113 Franklin Street, N. Y.
Reeder, H. J., Easton, Pa.
Reinecke, Theodore, Box 1651, New York.
Reynal, J., 84 White Street, New York.
Richmond, W. H., Scranton, Pa.
Roach, John C., Brooklyn, N. Y.
Robinson, R. E.
Rockford, A. P, Salt Lake City, Utah.
Rogers, A. L., New York.
Rogers, H. M., New York.
Roosevelt, Hon. Robert B., New York.
Rupe, A. C., New York.
Saltus, Nicholas, New York City.
Shultz, Theodore, New York City.

Smith, Greene, Peterboro, Va.
Sprout, A. B., Muncey, Pa.
Steers, Henry, 10 East 38th Street, New York.
Sterling, Dr. E., Cleveland, Ohio.
Stetson, J. A., Gloucester, Mass.
Stillwell, E. M., Bangor, Maine.
Stone, Livingston, Charleston, N. H.
Stoughton, E. W., Windsor, Vt.
Stuart, Robert L., 154 5th Avenue, New York.
Swartz, William H., Point Pleasant, Bucks Co., Pa.
Tagg, Henry, Philadelphia, Pa.
Thomas, H. H., Randolph, N. Y.
Thompson, H. H., 128 East 23rd Street, New York.
Thompson, John H., New Bedford, Mass.
Thompson, J. S. W., 31 Pearl Street, New York.
Tileston, W. M., New York.
Trimble, Dr. J. P., 221 East 12th Street, New York.
Van Cleve, Joseph, Newark, N. J.
Van Siclen, G. W., 99 Nassau Street, New York.
Van Wyck, J. T., New York City.
Ward, George E., New York City.
Weber, Samuel, Manchester, N. H
Weeks, Seth, Corry, Erie Co., Pa.
West, Benjamin, New York City.
Whitcher, W. F., Ottawa, Ontario, Canada.
Whitcomb, T., Springfield, Vt.
Whitehead, C. E., 61 Wall Street, New York.
Whitin, Edward, Whitinsville, Mass.
Wilbur, E. R., New York.
Wilmot, Samuel, Newcastle, Ontario, Canada.
Willets, J. C., Skeaneatles, N. Y.
Woods, Israel, New York,
Worrall, James, Harrisburg, Pa.
Yarrow, Dr. H. C., U.S.A., Washington, D. C.